SCIENTIFIC AMERICAN SUPPLEMENT

No. 657

Scientific American Supplement, Vol. XXVI., No. 657.
Scientific American, established 1845.

NEW YORK, AUGUST 4, 1888.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

THE PARIS EXHIBITION OF 1889.

In order to take in at a glance the vast panorama of the Universal Exposition of 1889, the scene must be viewed from the terrace of the Trocadero. At the foot of the palace we observe the beautiful park, which slopes very rapidly toward the Seine; opposite, in the axis of Jena bridge, is the immense arch of the Eiffel tower, between the pillars of which we distinguish at the end of the garden the great mass of industrial galleries that are symmetrically preceded to the left and right by the twin palaces of the fine and liberal arts, and that are limited to the rear by that wonderful machinery palace which will remain the boldest conception of metallurgists of our time. Almost everywhere, at the edge of the water, on the roads, on the lawns, there are pavilions, chalets, kiosks, rich palaces, rustic cottages, monumental fountains, hothouses, tents, colonnades—a sort of a strange city buried in verdure and flowers, a picturesque grouping of edifices of all epochs, of all countries, of all dimensions, and of all styles. Upon the whole, we have the novel impression that the entire modern world is here with its customs, its arts, its discoveries, the most complex manifestations of its life, its remembrances and its hopes.

THE TROCADERO PARK.

The galleries of the Trocadero, which are entirely occupied by the museums of moulding and ethnography, will remain as they are at present. The park, which was laid out in 1878 by Mr. Alphaud, will likewise be respected in its broad lines. It is reserved for the horticultural exhibit, for those handsome collections of roses, rhododendrons, magnolias, pinks, dahlias, chrysanthemums, etc., which are so rarely seen outside of

THE PARIS EXHIBITION OF 1889—THE CENTRAL DOME—INDUSTRIAL PALACE—M. BOUVARD, ARCHITECT.

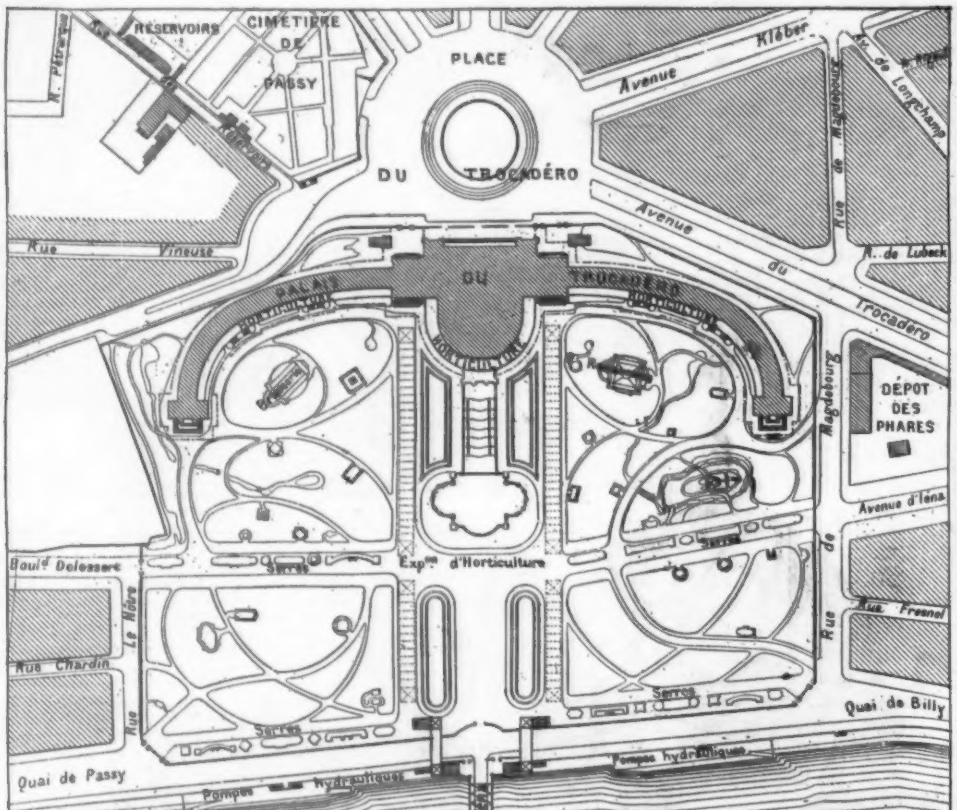
the gardens in which their owners cultivate and improve them with jealous ardor. Here, too, will be found shrubs, fruit trees, all the forest species, the inevitable pumpkins, with their usual retinue of monstrous asparaguses, gigantic radishes, microscopic melons, and red tomatoes, and, in the hothouses, May grapes, palms, tree ferns, gloxinias, cactuses, bamboos, orchids, carnivorous plants, etc., and perhaps a specimen of the *Victoria regia*.

The park thus transformed cannot be encumbered with edifices. There are constructing therein, however, a few pavilions designed for the minister of public works, for the administration of forests, for a restaurant, for a beer saloon, or for special exhibits. Through two small turrets opposite the doors of the palace access will be had to the abandoned mushroom caves, which extend under the Trocadero, and which a group of naturalists and engineers is engaged in converting into a geological museum. Here will be seen mine galleries, the successive stratifications of our globe, ores, fossils, all the surprises of a trip to the center of the earth.

As for the aquarium, which is more familiar to the Parisians who make Sunday excursions to Passy than to professional fish breeders, that will not be disturbed, but will be ornamented, restored, and restocked.

THE CHAMP DE MARS.

A foot bridge, which leaves free the Versailles road, connects the Jena bridge and Champ de Mars with the Trocadero park. This foot bridge and the Jena bridge crossed, we find ourselves upon the part of the Orsay wharf bounded by Suffren and Labourdonnais avenues—an extraordinary village in which the different types of dwelling, from the grottoes and lacustrine cities of the Stone Age up to the sculptural magnificences of the Renaissance, are collected.



THE PARIS EXHIBITION OF 1889—PLAN OF THE TROCADERO.

Immediately after this wonderful city, an erudite and artistic piece of work, the carrying out of which has been confided to the architect Charles Garnier, looms up so fine, so slender, so perfectly proportioned despite its colossal dimensions, that it does not throw into the shade any of the monuments over which the shaft towers. Every one now knows that this gigantic "nail" will weigh over fourteen million pounds, and will measure at the base of the lightning rod 395 feet more than the Washington monument.

In less than a month the second story will be finished, and, on the 14th of July, Mr. Alphaud will be able to set off upon this 400 foot platform a lot of fireworks that may be seen by the Parisians of Auteuil, Batignolles, Saint Maude, and Montparnasse without leaving their houses.

As vast as are the galleries designed for the exhibition of the various industries, they are not capable of accommodating the numerous foreigners and the still more numerous Frenchmen who have asked for space to present their products to the public therein. It has been necessary to erect in the park in which the tower is located an infinite number of buildings of all sizes and shapes to accommodate Brazil, the Argentine Republic, Mexico, Venezuela, Chili, Bolivia, Uruguay, Guatemala, Nicaragua, Costa Rica, Dominica, Hayti, Salvador, Honduras, and Colombia, and also a few private exhibits that could find no room in the galleries.

Behind this agglomeration of exotic structures, opposite the Champ de Mars station, is the palace of liberal arts, planned by Architect Formige. The entrance to this palace is denoted by two porches looking upon the English garden, and in the construction of which the artist has used terra cotta and gilded tiles. The palace is of iron, metallic architecture giving no "masses." In 1889 it will receive the exhibits of the ministers of justice and of the interior, and of the group of education and teaching (that is to say, printing, publishing, school materials, paper trade, etc.), materials for painting, drawing, and photographing, musical instruments, medical and surgical apparatus, instruments of precision, the maps and plans of the anthropological section, and of the retrospective history of labor, and, finally, in the aisles neighboring Suffren avenue, those of Servia, Greece, and the republic of St. Martin, the aisles bordering the garden being occupied by various restaurants.

In order properly to install the drawings, reproductions, reductions, and characteristic scenes in which the organizers of this curious revival of the past propose to present the history of labor and the anthropological sciences, Mr. Paul Sedille has constructed a wooden palace in Mr. Formige's iron one. Four open spaces have been reserved for those pieces of large dimensions which, as a whole, will present the history of the creations of human genius from the most primitive and rudimentary apparatus to the most recent and perfect productions of contemporary applied science. Upon gazing at this graceful, elegant, and convenient structure, one feels that it has been conceived by an artist of refined and very practical taste, and one singularly skillful in the utilization of the multiple resources that the modern industries hold at the disposal of architects.

The palace of fine arts is an immense hall in which musical instruments will be exhibited, and which connects with the galleries of the various exhibitions. Some of these galleries are arranged at right angles with the Seine and others parallel with it. All those at right angles belong to the foreign sections and form two distinct groups, separated by the English gardens, in which stand the pavilions of the city of Paris, and which descend in an imperceptible slope to the pillars of the Eiffel tower. The parallel galleries as a whole are divided in the direction of the axis of the Champ de Mars by a vast central promenade, limited in front by a majestic dome and behind by the main door of machinery palace.

The three central galleries at right angles with the river, devoted to musical instruments, will be occupied by Italy, Switzerland, the United States, Spain, Portugal, Luxemburg, Norway, and Japan. Russia will occupy the first parallel gallery, and after her will come the French industries in the following order: cutlery, jewelry, ceramics, glass, furniture, upholstery, tapestry, wall paper, perfumery, clocks, art bronzes, and apparatus for heating and lighting.

Through the central passage of the parallel galleries, it will be necessary first to enter the machinery palace. This latter will consist essentially of a main nave, 375×1,410 feet, the first story of which will be reached by wide stairways, and at the two extremities of which will be platforms 70 feet in width.

The building will cover an area of 910,620 square feet. It will comprise 20 metallic trusses, the two largest of which are at the extremities, and upon which will rest the entire framework of the roof. Steel will be used in the trusses. The roofing of the side aisles will be zinc, while that of the center will be striated glass, two and a half inches in thickness. The decoration will be very simple. Mr. Dulert, the bold architect who conceived and executed the plan, has endeavored to give the structure a utilitarian character. The machinery palace may be considered as one of the most original characters of the exposition, which includes so great a number.

On leaving this structure, we cannot return to the industrial galleries without visiting the dome of their facade, under which the Gobelins and Sevres manufacturers will exhibit their most magnificent products. This dome, by its situation, by the variety of the elements that enter into its structure, and by its sculptural decoration, will be one of the curiosities of the exposition. To the left and right of it, along the facades of the galleries, will run an open portico designed for restaurants, cafes, and beer gardens, and consisting of a fine metallic colonnade supporting a frieze that hides the extremities of the roofs under decorative "motifs" borrowed from the industries whose products will occupy the neighboring spaces. Such products are those that will be collected together in the second group of parallel galleries: first, against the machinery palace, wrought and unwrought metals, then, in succession, returning toward the garden, leathers, furs, chemical products, forest products, textile materials, oils, etc.

The last of the parallel galleries will be reserved for the Austro-Hungarian manufacturers, who will occupy the whole of it.

The galleries at right angles will be occupied by Belgium, the Netherlands, and Great Britain and her colonies. Bordering upon Labourdonnais Avenue will be located the special exhibitions of the Ceramic Union and of a few metallurgical establishments that would take up too much space in the palaces. Opposite England there will be a hall in which sculpture will be exhibited and which will open upon Rapp Avenue. Finally, will come the palace of fine arts, identical externally with that of liberal arts, and under the external galleries of which the visitors will find a reading and writing room, a smoking room, a hair dresser's shop and toilet rooms. The palace of fine arts will contain only a collection of the paintings and drawings executed during the last eleven years by the most celebrated French artists.

Around and in front of the palace of fine arts there will be a park occupied by chalets and small houses: The press pavilion, in which the Parisian journalists will offer hospitality to their provincial and foreign confreres; the bureau of post offices and telegraphs; the pavilion Louis XV., designed by Mr. Jacques for the Society of Pastillists; the pavilion of the aquarellists, and that of the principality of Monaco; the Swedish chalet; a circular structure recalling the choragic monument of Lysycrates; the pavilions of the gas, telephone, and tobacco societies; and many private buildings for exhibition purposes.

THE WHARFS AND THE ESPLANADE.

Before leaving the Champ de Mars, it will be necessary to cast a glance at the Seine barges containing the fluviatile and maritime exhibits—models of ships, fishing apparatus, rowboats, beacons, semaphores, sirens, etc.

On the Orsay wharf, from Labourdonnais Avenue to Faber Street, covered and closed galleries will receive agricultural instruments. At a point midway between the Jena and Alma bridges a special palace will be constructed for food products, and, around it, manufacturers will make and sell their various products.

The esplanade of the Invalides is to be almost wholly occupied by Algerian exhibits and those of the colonies.

PRESENT STATE OF THE WORK.

Work on the machinery palace is advancing rapidly. Seven out of the nineteen trusses are in place. The palace of the various industries is now ready for the reception of the interior installations.

The palaces of fine arts and liberal arts are both half finished. At present the pillars of the central dome are in course of erection.

For the above details and the accompanying engravings, we are indebted to *Le Monde Illustre*.

THE CANADIAN PACIFIC RAILWAY.*

WHEN British Columbia entered the Canadian Union in 1871, the principal condition of the union was that the Dominion should within ten years connect the Pacific seaboard with the railroad system of Canada, construction to commence on the Pacific coast in 1873. It was decided that the road should be built and operated by a subsidized private corporation, and a contract was made with Sir Hugh Allan on the basis of a subsidy of $30,000,000 cash, 50,000,000 acres of land, and perpetual exemption of the property from taxation. Sir Hugh did not form his company, the government changed, and in 1874 it was decided to build the road as a public work. In 1875 construction began between Lake Superior and the prairie region. Another change of government was followed by a reversion to the first policy of building the road by a private corporation, and in 1880 a contract was made with the present company.

The concession on the part of the government included a subsidy of $25,000,000 cash and 25,000,000 acres of land; right of way through public property; free import of all material for construction; the government to complete the sections then under contract, about 700 miles, and hand them over to the company as a free gift; all property of the company and its capital stock to be exempt from taxation of any kind. Besides these concessions there was the celebrated "monopoly clause," lately surrendered, by which it was provided that for a period of twenty years no line should be chartered south of the railroad except to run in a direction southwest or west of southwest. The company agreed to build 2,000 miles of railroad and to operate it ten years after completion.

A rapid survey of the financial history of the enterprise was given by Mr. Keifer, but is omitted here as being tolerably well known to our readers.

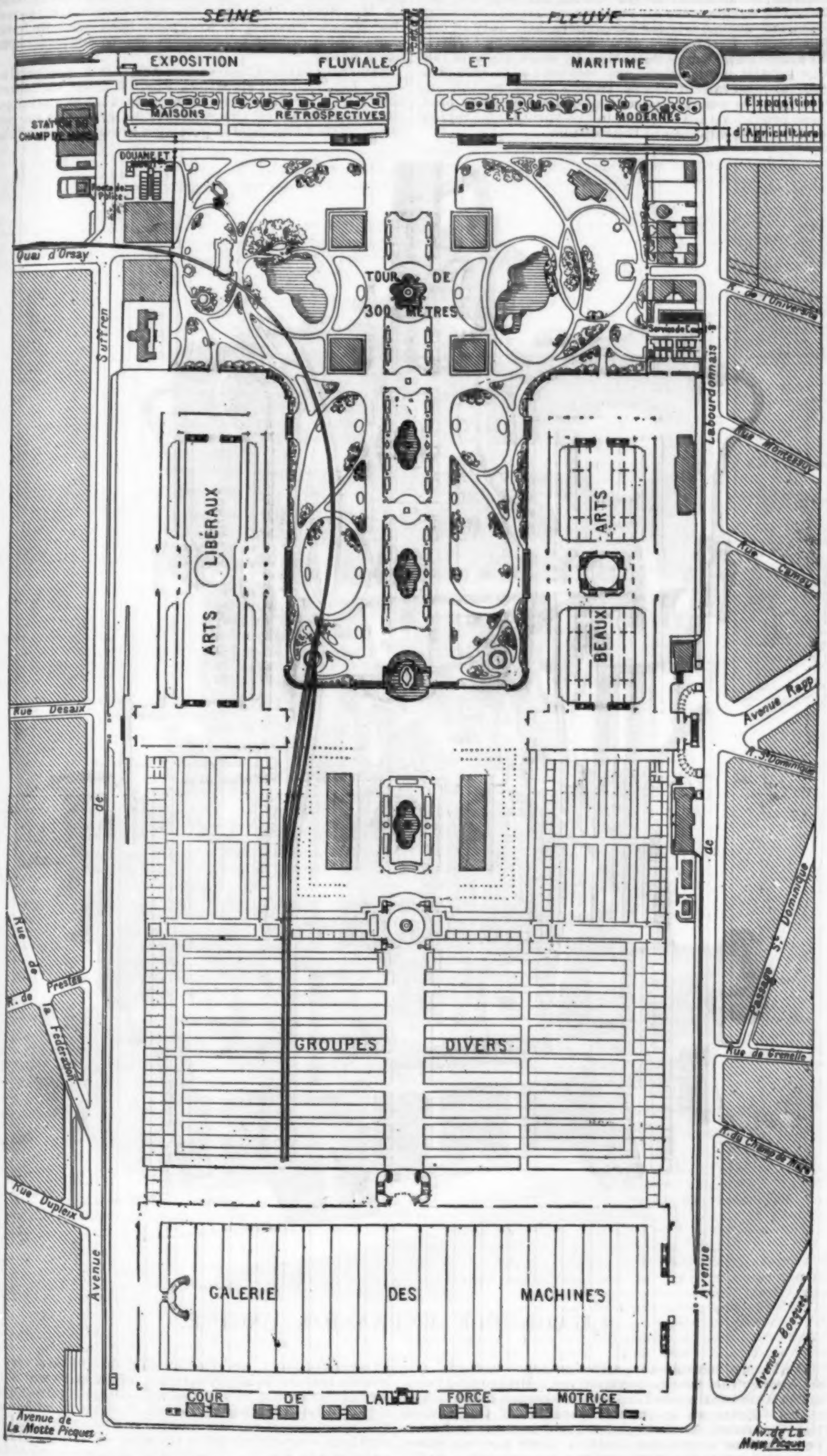
The general location of the Canadian Pacific, from Montreal to the Rocky Mountains, is governed by three great geographical features, Lake Superior, the Lake of the Woods, and Lake Winnipeg. It must go north of the first two and south of the third. Passing from the Ottawa valley into that of Lake Huron, the line traverses, for about 100 miles, the watershed of Hudson Bay near the height of land. Descending to Lake Superior, numerous long rock cuts are encountered, separated by shallow valleys, generally with marshy bottoms and little material for roadbed near them or over them except solid rock, bowlders, and hard pan. Timber being abundant, the grade was thrown up, and trestling was freely resorted to, thus reducing the depth of the rock cuts, and also the difficulty from

* An abstract of the annual address of the president of the American Society of Civil Engineers, Mr. Thomas C. Keifer, read at the annual convention of 1888.—*Railroad Gazette*.

snow, which generally falls to greater depth than on any other portion of the road, with the exception of the Selkirk Mountains. Along the eastern shore of Lake Superior are much heavy rock work and numerous tunnels. The rock excavation runs up to hundreds of thousands of yards on some miles. The cost of one mile is said to approach $700,000. The highest summit between Montreal and Lake Superior is 1,550 ft. above tide water, and between Lake Superior and Red River it is 1,560 ft. The maximum grade in either direction between Montreal and Lake Superior is 1 per cent. and the sharpest curve 6 degrees. Between Lake Superior and the Rocky Mountains, the maximum grade going west is, with one exception, 1 per cent. Coming east the maximum is 40 ft. to Winnipeg, and 25 ft. thence to Lake Superior. There is one grade going west from Lake Superior which exceeds the established maximum; that is a short grade starting from Medicine Hat, a divisional station, where a pusher is used.

There is an interesting example of rail creeping on a highly elastic roadbed on this division, where the line crosses a "muskeg," the Indian name for bog. The roadbed here yields about 6 in. to every passing train. With a consolidation engine hauling 85 cars, the track crept 26 in. in the direction in which the train was moving. The rails creep for about ¾ of a mile east and about ½ a mile west of a small bridge at the foot of a grade in both directions. They creep with every train, and in warm weather will often run 12 in. under an ordinary train. Cinder ballast keeps the track in fair line and surface, but does not in the least prevent the creeping of the rails. Spikes must be left out each side of the angle plates, otherwise the creeping rail would carry the ties with it. The whole muskeg, when a train is passing, shows a series of short waves 5 to 6 in. deep. The general superintendent of the western division, Mr. Whyte, proposes to use 12 ft. ties, 40 in. angle bars, and cut a slot in alternate sides of the rail at every tie.

During the construction of this part of the road, some rather serious questions rose out of interpretations of the contractors' specifications. Separate prices were made for granite (the country rock), mica schist, and trap, and for trap different prices were made for cuttings under 3 ft. and over 3 ft. deep. Separate prices were also stated for hard pan and cemented material, but tenderers generally did not recognize any difference in their bids, no doubt because the specification applied the same test for both. It read: "Hard material, where a good picker cannot keep more than two good shovelers going, shall be termed hard pan, or cemented material, as the case may be." The price for hard pan and cemented material was 80 cts. (more than double the earth price); the good picker and the two good shovelers could not be expected to be always together, and however numerous the former might be at any time or place, the pickings were good whether the pickers were good or not. As to solid rock classification, the results on one division were surprising. The geology of the route, which consists largely of metamorphic rocks, was "altered," decidedly. Trap under 3 ft. was $3.40 per yard, while granite was $2.20, and more trap was returned at this price than could have existed had all the cuttings been floored with it. When trains could get through, the company's chief officers found their ballast trains working in cuts where there was no ledge rock, but in which large amounts, including trap, had been returned. They ordered a remeasurement, which was confirmed by another one made by the court, and on one contract the final estimate was reduced between $300,000 and $400,000. Other similar cases on this division were settled on the basis of the remeasurement. The section engineers who measured and classified the work in the first instance were, generally, in accord with the remeasurement, and the sub-contractors were settled with on their classification. After the sub-contractors had been paid off, a revised classification was made out for the final estimate, in which the formation was altered, as effectually as by an igneous eruption, granite merging into mica slate, and trap overflowing everywhere.



THE PARIS EXHIBITION OF 1889—PLAN OF THE CHAMP DE MARS.

The Prairie Section.—For various reasons, the company decided to abandon the location which had been adopted by the government from the Red River to the Rocky Mountains, and to follow a line nearly due west on the 50th parallel, both to shorten the through distance and to leave no room for a competing trunk line on the south.

In the prairie sections the line has been kept in embankment everywhere possible as a precaution against snow blockades, and for the same reason slopes have been widened and flattened and the spoil deposited well away from the line as a snow screen. At stations, sidings are thrown out so far that cars standing on them cannot cause drifts on the main line. Only twelve miles of snow fencing are used on the prairie section. There was no detention from snow last winter between the Columbia River and Lake Superior exceeding four hours at any one time. For 400 miles west of Winnipeg there is no good gravel in large quantities, and pockets only sufficient to ballast the wettest portion of the road. The top prairie soil is used for surfacing.

The Mountain Section.—In Canada the Rocky Mountains may be said to terminate as a distinct range between the 51st and 52d parallel; thence descending to the Peace River Pass, latitude 56 degrees north, which is only about 2,000 feet above sea level. This is the first river which cuts entirely through the Rocky Mountains, and heads west of the range, draining the table lands between the coast range and the Rockies. Between Peace River and the international boundary, ten passes have been explored, all lowering as you go northward, diminishing from 7,000 to 2,000 feet in altitude. The Yellow Head Pass, with an altitude of 3,733 feet, had been selected by the government in the first instance as the route for the railroad. The timber line, in the Canadian Rockies, is about 7,000 feet above the sea, and above the altitude of 6,000 feet snow falls to some extent every month of the year. Above this elevation there are large patches of perpetual snow, and true glaciers are found there. The mountain section of the Canadian Pacific extends from the eastern slope of the Rockies to the terminus at the city of Vancouver, 522 miles by railroad, but less than 400 as the crow flies.

The Bow River valley led up by an easy route from the 50th parallel to more than one pass. In descending the western slope of the Rockies, by the Kicking Horse Pass, the most southern available one, the line leaves the valley of Bow River by ascending one of its tributaries about three miles, to a marshy summit 5,300 ft. above tide water, and the pass is without cutting or tunnel. Eastward from the point where this line leaves Bow River there is no grade to Atlantic tide water exceeding 1 per cent., but immediately after crossing the summit the heaviest grade on the whole line is encountered—4½ per cent. on two stretches of 3¼ miles each. All the gradients on the Canadian Pacific which exceed 1 per cent. are concentrated upon the 134 miles which lie between Bow River and the point 1¼ miles west of Albert Canon on the western slope of the Selkirk range.

No trail has yet been discovered over the Selkirk range, but the distance across this range in the direction aimed at was less than one-third of the distance following the river northward around it by the fifty-second parallel, and therefore strenuous efforts were made to find a pass, which, after repeated trials, was effected by Major Rogers, M. Am. Soc. C. E. This Selkirk crossing, the summit of which is 4,300 ft. above tide water, penetrating a previously unexplored region, is one of the few cases in which the locomotive preceded the Indian in the formation of any kind of trail. The mountain work is not heavy, but its cost is in structures over and under the track, which are called for for protection against snow. Strong and costly sheds are required to meet the avalanches, and large bridges merely to get out of the way of them.

During the winter of 1885–86, engineers were left in the Selkirks to study the requirements as to snow sheds, and in the following summer 35 sheds were built, having a total length of four miles. The experience of the next winter caused the further increase of these snow sheds to six miles, and a still further increase of about a mile is found to be necessary.

These sheds are designed according to the service they are to perform: (1) for protection against snow falls only; (2) for protection against avalanches from one side; (3) for protection against avalanches from both sides. The latter are called valley sheds, are flat roofed and cost about $66 per lineal foot. The typical avalanche sheds are built with rock-filled cribs on the mountain side and braced framework on the other side. These cost $40 to $70 per lineal foot. The gallery shed has no crib work, but the roof is carried up against the mountain side by strong framework. These cost $15 to $40 per lineal foot. These gallery sheds usually flank the typical sheds. The sheds are cut at intervals for light, ventilation, and to arrest fires, and opposite these cuts are screen fences or glance works arranged with a strong apex up hill in the path of the snow slides and wings curving off to direct the snow to the point protected by sheds. A summer track is often carried outside of the sheds for greater security against fire, and to permit travelers to see the country as they pass. The total expenditure for snow sheds and other

work for snow protection has been $2,900,000, and it is proposed to expend $200,000 more to complete the system.

When snow sheds are near together, the telegraph line is carried by underground cable, and the only interruptions of telegraphic communication along the road last winter were from wind storms, and in no case was communication cut off more than four hours.

Of course expensive protection against fire must have been provided for the sheds and other structural works, as well as for the preservation of forests. In many cases flumes are carried along the roofs of sheds and filled with water from the mountain brooks. In other cases pipe lines are laid through the sheds. The locomotives are provided with hose connected to the injector by globe valves, and tanks of 6,000 gals. capacity are kept on flat cars at sidings.

The snowfall of 1886-87 was the heaviest ever observed in the Selkirk country, exceeding 35 ft. at the summit of the range. Eight and one half feet fell in six days. The sheds stood up well, although loaded with snow 50 ft. deep, and weighing 30 lb. per cubic ft.

One valley shed not entirely finished was struck by an avalanche, and the roof carried 200 ft. up the opposite side of the valley. The shed was filled with snow, which was piled 30 ft. above it, and in clearing it out empty spaces were found in the shed large enough for a man to pass through, evidently caused by the confined air, indicating the rapidity of movement of the snow slide. A rock slide of 100 cubic yds. passed over one of these sheds, leaving a rock of ten tons weight on the roof.

The avalanches start sometimes 4,000 or 5,000 ft. above the level of the track, and bring down a quarter of a million cubic yards of material. They creep over the slope of a glacier or of old packed snow till a steep slope is reached, and then with tremendous velocity sweep down into the valley, sometimes crossing it and ascending the opposite slope 200 or 300 ft. Sheds more than 100 ft. above the valley have been struck by avalanches from the opposite slope. The avalanche is accompanied by a hurricane, locally called a "flurry," which uproots trees or snaps off their tops to some distance either side of the path of the avalanche, and against these flurries the trestles and bridges must be protected by guys. The superintendent of the Pacific division is confident that with the additional three quarters of a mile of snow shed now planned there will be no further serious interruption to traffic from avalanches.

Mud slides have given great annoyance in the Selkirks, particularly on the western or wetter slope. They have often necessitated cleaning out cuts with steam shovel and derrick, and are guarded against by double rows of piles, 8 ft. apart on each side, braced, and the space between filled with gravel, which is also used behind the outer row of piles.

The bridging in the mountain section is entirely of wood, except the cantilever over the Fraser. There are in the Selkirks three bridges, 154, 175, and 294 ft. high respectively. The last, the Stony Creek bridge, is 490 ft. long, with one span of 172 ft. It will soon be replaced by a steel arch springing from the sides of the V-shaped ravine about half way up. The metal bridges east of the Rocky Mountains are of heavy pattern, designed by the late C. Shaler Smith, M. Am. Soc. C. E.

By crossing the Selkirks instead of going around them in the Columbia River valley, the road is shortened 80 miles. Leaving the valley of the Columbia, the line crosses the Gold range through Eagle Pass, the summit being only 1,800 ft. above tide. From the western side of the Gold range, the line follows the shores of lakes and rivers draining into the Pacific. Here is heavy work and tunneling, but it is when the line descends the Fraser River, cutting through the Coast range, that the heaviest consecutive 100 miles on the whole route is encountered. This section, built by the government, cost about $10,000,000, without rolling stock or stations. There are numerous tunnels and rock cuts, and a cantilever bridge of 300 ft. span, designed by Mr. C. C. Schneider, M. Am. Soc. C. E., crosses the Fraser River. This was the second cantilever built on this continent.

Divisional points are established at intervals of 125 miles. At these points, tracks, round houses, etc., are laid out on a standard plan. At alternate divisional points repair shops are established. At all divisional points are water tanks, 40 ft. high, to give sufficient pressure for washing out engines, and at the alternate divisional points are wrecking cars, pile drivers, tool cars, bridge and track material, and other emergency material. In the new country, stations are arranged at intervals of 16 miles, passing tracks are laid about half way between these stations, making the crossing interval generally eight miles. This is reduced where there is considerable traffic.

The fuel supply is: Nova Scotia coal for the Eastern system; Pennsylvania coal, from near Ottawa to Brandon, the first divisional station west of Winnipeg; and west of Brandon, Canadian tertiary coal from the Bow River deposit is used until it is met in the mountains by Pacific coast coal from Vancouver Island. The Bow River coal is estimated to be within 15 per cent. of the value of Pittsburg coal. Anthracite is being worked alongside the main line in the Rocky Mountains, and is used for passenger cars and domestic purposes as far east as Winnipeg. The Bow River coal area is estimated to contain three hundred and thirty millions of tons, and will be the chief source of the supply for the prairie region. Natural gas has been discovered in boring for water near the foot hills, and is used for pumping at two of the company's stations.

The locomotive equipment of the Canadian Pacific has already been described, in more or less detail, in the *Railroad Gazette*. The consolidation locomotives working in the Selkirk Mountains are equipped with the Westinghouse brake on the two forward drivers, the American steam brake on the two rear drivers, and the water brake. The automatic brake is used ascending grades, and straight air descending, with hand brakes manned. The block system with telephone addition is extensively used in the mountains.

In winter the consolidation engines are provided with heavy pilot plows. These plows are made of 5-16 iron double plated at the nose, with steel angles and 6 in. by 1 in. iron strap stays. The height of the nose is 5 ft., and of the wings, at their extremes, 7½ ft., clearing a width of 9 ft. at the bottom and 10 ft. at the top. These plows are often used ahead of the larger winged plows. For the efficient working of the snow plow train through the mountains, it has been found necessary in many places to move the line out from the hillside to leave room for the accumulation of snow on the slopes. In descending long heavy grades, the freight trains make frequent stoppages to cool off, and prevent the breaking of the cast iron wheels from excessive heating by the brakes. On the Selkirk division, 72 lb. steel rails are used, with 3,500 ties per mile.

The company have omitted no precautions to secure the safety and comfort of passengers. For hundreds of miles no supplies can be procured except by train, and in view of detentions, each through train, from Montreal, in addition to the dining car supplies, carries in the baggage car an emergency box of provisions to be used exclusively for passengers, and only in case of necessity. Besides this, at nine points in the Selkirks and Eagle Pass, where detention by snow slides is possible, provision magazines are established in safe positions, at intervals of ten or twelve miles, so that no train may be caught more than six miles from food. These provisions are emptied in the spring, and replenished by fresh supplies in the autumn.

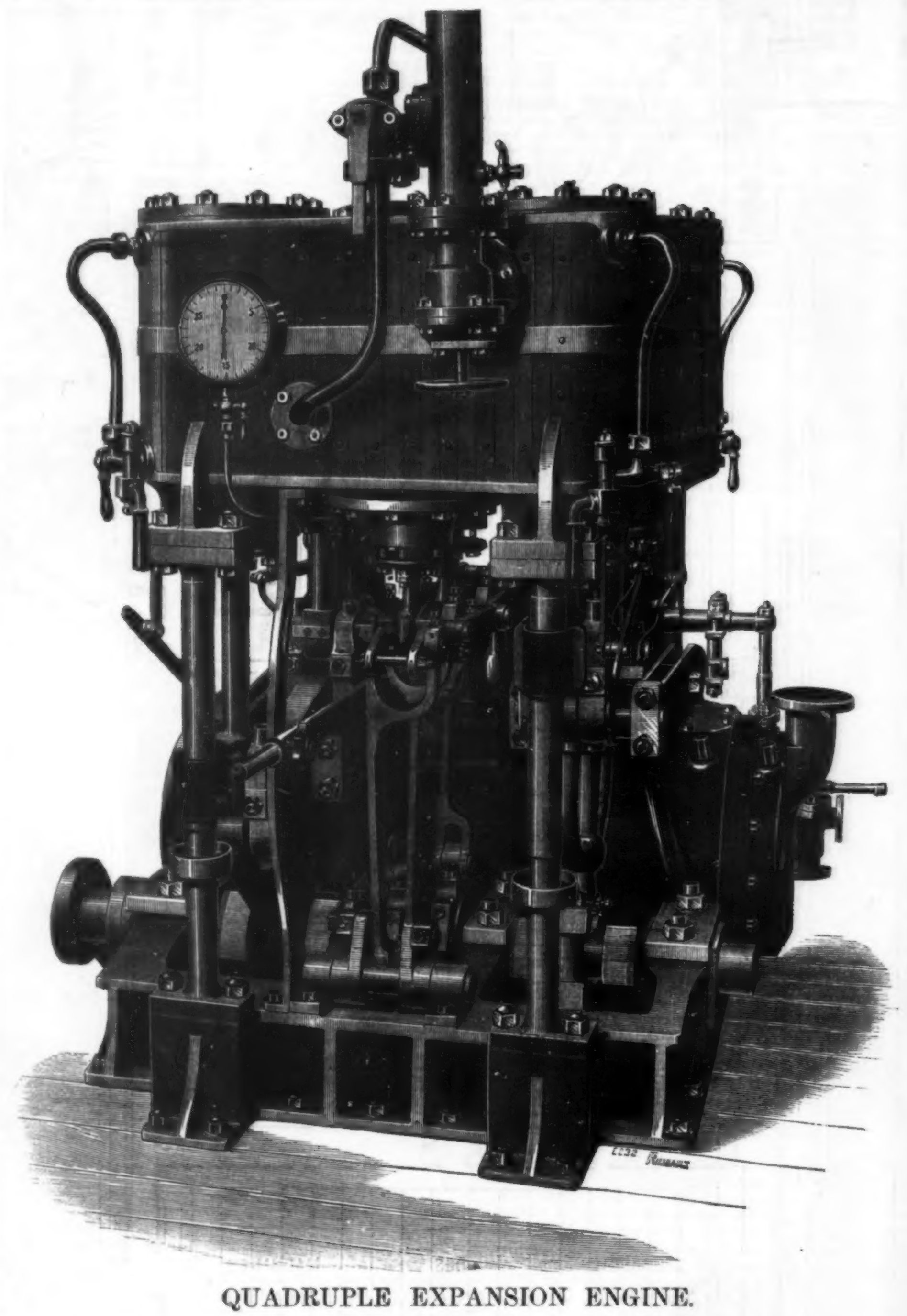
Coal and oil supplies are also similarly "cached," and emergency fuel for the locomotives. Bridge and track material is held loaded on cars to shorten detention of trains. Extremes meet; the voyagers of the Hudson Bay Company, Arctic explorers, and hunters and trappers in the mountains, cached their surplus stores against the ravages of fire, wolves, the wolverine, or the polar bear; and now the most recent specimen of the highest type of transportation confirms by its emergency magazines the wisdom of the pioneers in the old times before the railroad era.

For local passenger traffic, which, from the sparseness of population, has, like the freight business, to be created, there is chiefly that of prospectors for minerals and timber, ranchmen, miners and lumbermen, and settlers in the new towns, which can be regarded as tributary to the road. Through traffic with all the Pacific coast is competed for, and tourist travel is specially cultivated. For this, the route through the mountain region offers exceptional attractions, and no expense has been spared to make the most of this class of traffic. The hotels at the National Park in the Rockies, and at the terminus, Vancouver, are, like all the company's equipments, modern and complete. The scenery is Alpine, the route the only glacier one in America, and comfortable hostelries have been established in the mountains for stop-over tourists or sportsmen wishing to hunt the Rocky Mountain goat, now almost limited to these latitudes; the big horn, the grizzly, and the mountain lion; or farther north the caribou, and in the foothills deer, elk, and antelope; or to cast a fly in the trout streams and lakes of the mountain region.

QUADRUPLE COMPOUND ENGINE.

We give four views of a new type of four-cylinder compound engine lately introduced by Messrs. Fleming & Ferguson, of Paisley. Our illustrations are taken from the drawings of small engines of about 120 horse power, which are to be placed in a yacht being built for Mr. Sholto Douglas. We may mention, however, that Messrs. Fleming & Ferguson have now in hand engines of a similar type which are to indicate 1,800 horse power.

Referring to our illustrations, Fig. 1 is a perspective view, Fig. 2 an end elevation, Fig. 3 a front elevation, and Fig. 4 a plan. It will be seen that the arrangement is peculiar, all the cylinders being placed on one level. The advantage in getting a lower engine will be at once apparent, and this at least should be a very desirable feature in applying these engines to war ships. As neither of the two piston rods of each pair of cylinders can be over the crank shaft, the axis of which is in the usual place in the middle of the engine bed, the ordinary connecting rod is replaced by a steel casting, as shown in Fig. 2. Attached to the crosshead of each piston rod is a link, the lower end of these links being attached to the triangular steel casting which takes the place of the connecting rod. The lower end of the casting has brasses in which the crank pin works in the usual way. There is a lever, or rock arm, which pivots on a pin in the engine framing, the other end being attached to a pin on the connecting piece, as shown in Fig. 2. In the engine in question a prolongation of this arm is used to work the air pump, etc. The two pistons of each pair of cylinders ascend and descend not quite together, one being a little in advance of the other. Consequently, there is no dead center for either crank.



QUADRUPLE EXPANSION ENGINE.

The sequence of the cylinders will be seen from the plan, Fig. 4. Steam is admitted to the high pressure cylinder by means of the piston valve placed between the two first cylinders. The steam passes first into the space between the flanges of the valve, and not into the steam chest. From thence it is admitted to the

cylinder through the center cylinder port, and, having done its work, exhausts into the casing. It must be now explained that the valves to each pair of cylinders are placed one above the other on one valve rod, and work in one steam chest common to both. It will be seen, therefore, why it is necessary for the boiler steam to be admitted inside the valve, or, in other words, between the flanges, as otherwise the high-pressure steam would pass into the second cylinder as well as the first, the valve chest space being common to both valves and cylinders. The steam escaping from the first cylinder fills the valve chest, and is admitted to the second cylinder in the usual way, the exhaust this time being carried by the inside of the valve. Steam is then taken to the next two cylinders, and the same action is gone through once more, until the steam escapes to the condenser in the usual way.

The valves are worked by eccentrics and reversed by link motion, but the arrangement is necessarily peculiar. The valves for the third and fourth cylinders are placed directly over the crankshaft, and can be worked from eccentrics in the usual way. The valves for the first and second cylinders, however, are considerably on one side of the fore and aft center line. In order to work the valve rod common to these, an arm or connecting rod is taken from each of the eccentric straps, and these arms work the link motion by means of a bell crank lever attached to the engine bed. In Fig. 2 the arm of one eccentric can be plainly seen, together with the bell crank lever, and the connecting rod carrying the motion to the solid bar link. The reversing links are placed one immediately in front of the other, and are pulled over by one lever and drag links. It will therefore be seen that only two eccentrics are used for all four cylinders, and only one would be required in a non-reversing engine.

The standards of the engine are used as crosshead guides, and the rubbing surface is less than usual, but with the arrangement of connection between crosshead and crank pin here shown, the side thrust is very small, and there is little wear on the slipper guides.

The advantages the makers claim for this design of engine are that free access is offered to each cylinder, less fore and aft space is taken up, and also less height. There are fewer wearing parts and less attention in running is required, consequently, a cheaper upkeep is obtained. The two cranks being placed directly opposite each other give a balance of moving parts. It is also claimed that the turning action of the four pistons on the crank shaft is equal to four cranks at right angles.

These engines are, we are informed, designed to work at a pressure of 180 lb. to the square inch, and have been run light at 400 revolutions per minute. We had an opportunity of seeing these engines at work at Messrs. Fleming & Ferguson's works a few days ago, and they certainly ran very smoothly and pleasantly. The test was not a fair one, however, as the boiler pressure was only 60 lb., and the last cylinders could have been getting very little steam. The diameters of cylinders are, first cylinder, 7 in.; second cylinder, 9 in.; third cylinder, 12½ in.; and fourth cylinder, 18 in. The stroke is 12 in.—*Engineering.*

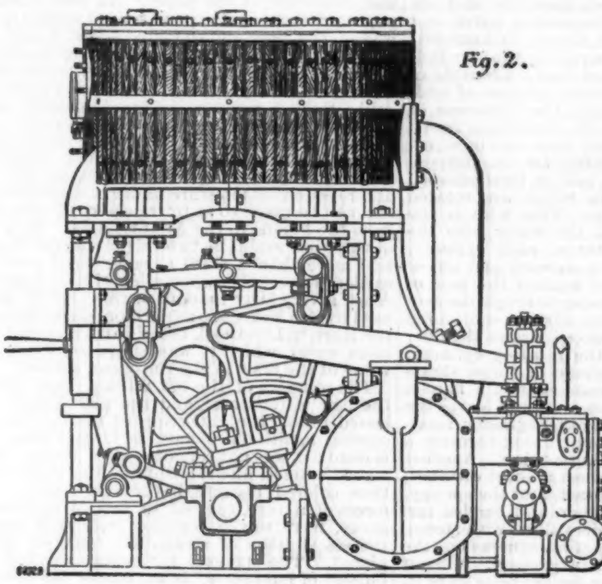


Fig. 2.

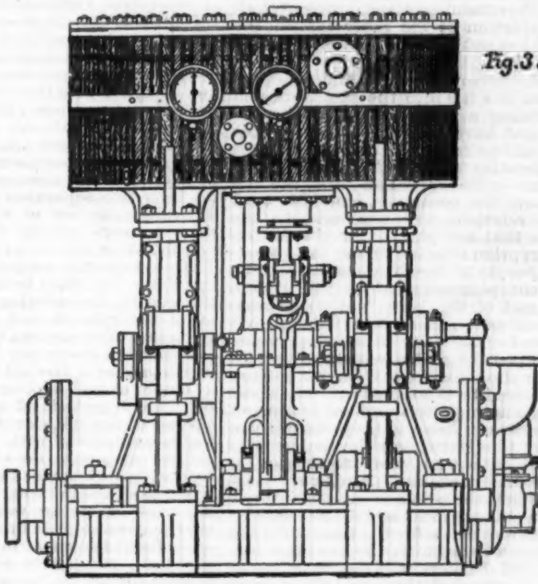


Fig. 3.

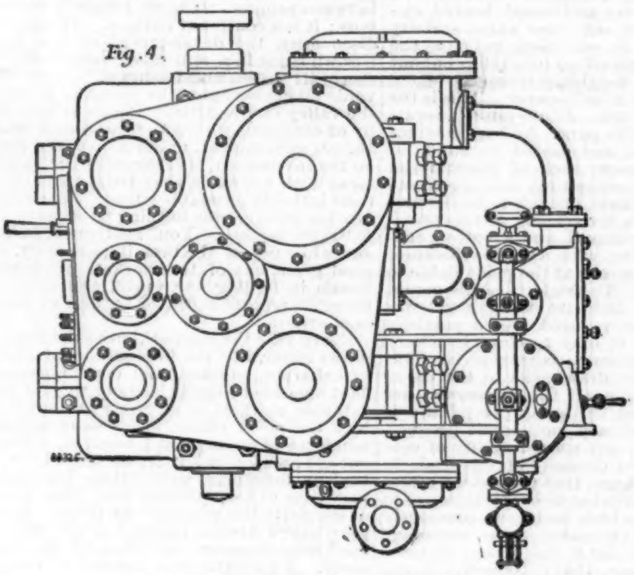


Fig. 4.

QUADRUPLE EXPANSION ENGINE.

HOW TO PREVENT BOILER EXPLOSIONS.

To the Editor of the Scientific American:

I quite agree that the Silesian German boiler disaster (published and illustrated in SCIENTIFIC AMERICAN SUPPLEMENT of May 12, 1888) is one of the most serious in way of destruction of property on record. With all the investigations made by the boiler inspection societies and engineers, in my opinion the true cause has been overlooked. I have had constant charge of boilers, both marine and stationary, of many types and sizes, for many years, and have made the care of boilers a careful and diligent study, and therefore think it my duty to publish what I have learned, both for the safety of human lives and safety of valuable property. A glance at the illustration, Fig. 1, shows plainly the cause of that accident.

That the general type of these boilers appears to be liable to destruction (in the way I intend to illustrate) *is true,* not only with that type, but with any type lying horizontally and wholly above the fire.

The German inspector investigations have been carefully carried out, and the gas explosions, the question of over-pressure, and the setting and general arrangement of the plant is plainly and substantially set forth, and should, in my judgment, be fully taken as correct; and an extension of said investigation seems to be invited. It is said that those boilers cracked at the seams (circular) previous to the explosion, which was laid to the poorness of the plate. Now this is a proof in my favor. Cannot we now know that destruction was mysteriously going on, cracking the shells exactly as was found after explosion? We must know that it was only a narrow escape, and a little more of the cause applied would have brought the explosion at that time. I will venture to say that, if those boilers are examined, the so-found bad metal is still in them; and from the fact that they stood with the working pressure, they must have been good enough; and upon examination the so-called bad quality will be found at top of shells of those boilers. But they did not crack at that point previous to the explosion, and why? Because there was a greater strain going on at the bottom than at the top. The explosion shows it also. It is agreed, too, that the explosion took place at a time when the boiler pressure was no more than usual, and perhaps less, as the fires were banked. Over steam pressure could not have taken place without warning to some one or more of the three men on duty, by way of some one or more of the many safety valves, or the noting of pressure gauge, with which undoubtedly they were supplied. Furthermore, it is stated that, if carelessness or neglect, it must have been agreed to by all those three men. Now, I am not going to say that the cause of said disaster was agreed to and carried out by those three unfortunate men; and neither do I wish to be understood as reflecting any discredit or blame to those men. But I *do* say that we, as mechanics and engineers, have unknowingly set traps for innocent men to spring, as I have stated already, a look at the illustration, Fig. 1, showing it. Please note the position of feed water to boilers. The water going in at the bottom is, and was, the cause of the explosion, and those men agreed to put the pumps on when the boilers were at rest to assist in keeping steam pressure down, acting in conjunction with the banked fires. It is a very common thing for firemen and engineers to start the feed water to keep steam low while the engine is at rest; also to have extra head of water bottle up, that firing may be easier kept up for a time in consequence. Is not this a known fact?

I do not know whether said feed water was hot or cold, but am of opinion that at or near before explosion the water was most likely to have been cold, for generally feed water is heated by exhaust steam, of which there was none, according to reading of the affair. It also is said that there was no occasion for low water, for the pumps were ample and good water supply.

The pumps being ample or over-ample is also an additional text for my argument. There are natural laws concerning expansion by means of heat—one of our greatest known powers—and the reverse, contraction, or shrinkage, by the reverse of heat, exact proportions, as per experiment shown by Haswell, Roper, and many other good authors. When looked up, will show that, on putting cold or even warm water in those boilers abundantly at that point, and at that moment, would cause the lower sides of these boiler shells to shorten some parts of an inch or inches, while the heated, or top, remained almost unchanged. Now, cold water always lies at the bottom till heated, when it will begin to rise; so, therefore, the cold water will settle or gain equilibrium throughout the whole system of said boilers, and it would be impossible to strain the boilers unequal from each other when the water went in equal, and steam heat being also equal at the top; hence the curious instantaneous cracking of most of the boilers. The extra strength or thickness of plates, or a boiler constructed throughout of extra stout material and subjected to foregoing usage, has nothing to do with its safety; in fact, a steel boiler (the best material, we are beginning to think, we have for boilers) is in the most danger, for the bottom part of the boiler is caused to pull against an upsetting strain at top of same shell, and the upsetting is applied to something over half of the shell; and if proportionately the other way, the pulling part could not stand the strain that the pushing part could stand is the reason breakage takes place in circular seams at the bottom where the pull comes. The cracking of boilers from this cause is always confined to the circular seams, and why not the same be true of the lengthwise—the seams, too, which are compelled to stand the most strain from good square steam pressure, because the boiler is free to come and go by its shape? I have had many examples of the same kind, and of course more notable with the before-mentioned style of boilers, although by careful observation it is notable to some extent in other classes of boilers. In fact, I am sure that I have saved, in several instances, disasters by looking to this same cause. I can talk about this matter for many hours at a time, and with intelligence, too, as can be proved by experience.

In the SUPPLEMENT of later date than that in which I saw the German boiler explosion, I read a Sibley College lecture on setting and care of boilers, which, no doubt, grew from said explosion; and on seeing the illustration, at once I said to myself, the feed water dangers have come to light; but on reading I found that while the lecture is very ably carried out, as shown both by theory and practice, yet the long looked for and most overlooked thing is left out.

I am in charge of a plant of eleven boilers, and when I took charge of them, six years ago, all of the boilers were leaking at their bottom circular seams, and all alike to the same amount at the same time, notwithstanding their different styles, different sizes, different grades of material, etc. This leakage was a mystery to all attendants. In fact, every seam (circular) except the end ones was at times leaking, and those nearest to centers of boilers were broken circumferentially a length from 12 in. to 30 in. You might say, Why then did your boilers not explode? Answer: Because the steam pressure never overrated 40 lb. per square inch, a pressure that the boilers could readily stand, even

though they were broken to amount of one-third of their actual strength.

This thing went on for many seasons, and, as I understand, was pretty thoroughly looked up and several changes made about the boilers, but to no purpose. Upon taking charge, I went about changing the feed water, discharging it into the boilers in a manner not to allow cold or even water of less than boiling heat to touch the bottom or any other parts of the boiler shells, when, to the joy of all concerned, the boilers stopped leaking, or so near that even the soft patches that we were compelled to renew every Sunday gave evidence of standing good for six months. After making said change, I cut out and properly hard-patched the broken seams, and now can say that for the space of five years, to this date, have had constant, uninterrupted use of said boilers. The above is only one of more cases of the same character that I might mention both in marine as well as stationary boilers.

S. J. Randall.

Moodyville, British Columbia, June 16, 1888.

BAGS AND BAGGING.*

Gentlemen of the Millers' Convention: It is a very old story that the "rolling stone gathers no moss," yet it is evident from the rotund gentlemen present that, previous to the introduction of the roller system, the "rolling stone," if it has not gathered moss, certainly accumulated some money.

You have convened here to talk shop, and therefore I hope to be pardoned if I fall into the same rut, and also indulge in babbling a little business. The immense investments that have been made in your line make the aggregate milling fraternity one of the most important and influential classes that control and handle a stupendous industry. You are the tie between the farmer and the consumer, and hold in a certain way divine relations to existence. In the quaint hieroglyphics that are painted or chiseled on the interior of the Egyptian temples among the numerous deities that the people of the Nile worshiped, one that appeared more conspicuously and frequently than any other was the "god of the belly." Although the old idolatry has passed away, there is yet enough left of hereditary respect for the deity to look upon you with the profoundest regard as his redoubtable high priests. If the miller should slip out from our civilization—although of course this is not possible—the whole race would be brought not only to suppliant knees, but to its aboriginal grinders. There is no probability of this, however, for in the Darwinian development of mechanical skill and enterprise you are moving at rapid strides to economize more and more, and cheapening farther and farther the prime necessary of life.

The business in which I am most largely interested—that of producing the receptacle for the transportation of your product—was in its primitive beginning a very ancient trade. The cliff dwellers, who dug their houses in the sides of the canyons of the great West, were skilled in the art of weaving or braiding bags, and there are in our museums numerous evidences of their great ingenuity and skillful work. They made a bag without seams, of the finest grass, and shirred the top with a permanent string. In this they transported from place to place the pulverized maize of those very, very early days.

I think it was about thirty years ago that I first introduced myself to the gentlemen of the "bolting cloth," and found the cotton bag of that period was simply the domestic muslin of to-day, nipped on the selvedge with a pair of scissors, torn across its width, and sewed by hand for the uses of the mill. Printing was little thought of, and this package was simply used to replace the familiar pillow case, which was brought by people of even fair means to the mill, to be filled with flour. This state of art was of brief duration, and a more convenient and elaborate package was demanded. The invention and use of the sewing machine made it possible to produce upon a larger scale a convenient and more economical vehicle for the transportation of flour. When, in 1861 to 1863, cotton was so enormously enhanced in price by the blockade of the Southern ports, and the risk and difficulty of smuggling so ponderous a material across the line, a one-fourth barrel cotton sack leaped from the original six cents value to thirty, and even a higher price. Barrels were worth ten shillings, and no other than these two forms of package were known. I may be allowed a little egotism, perhaps, in stating that it was through the menace to the cotton sack business that I was stimulated personally to see if some other material could not be used to replace it. Knowing but little of the material that entered into the fabrication of paper, I spent a few weeks in reconnoitering from Bangor, Maine, to Long Island Sound, scrutinizing every paper mill—not very many at that time in New England—to see if it were possible to construct a bag of sufficient strength out of some known material. My mission so far as discovery was concerned was a total failure. No material of sufficient strength to withstand the abrasions of transportation had been devised in paper shape. In pursuing my inquiries, I was materially aided by the scientific assistance of an old friend in Albany, well known to the paper makers of the United States—Mr. Charles Van Benthuysen—who, in giving me a history of the various fibers that possibly could be used to attain the desired result of a flexible and durable package, incidentally remarked that old rope—then cast out at the back end of the paper mills to slowly rot away—would, if it could be reduced from its incorrigibility and kinkiness, make probably the strongest material that could be used; but the obstinacy of the material, and the impossibility of reducing it by any ordinary chemicals used in the conquest of paper fibers, made it an apparent impossibility. Inquiring further as to the processes that were used, I learned that hardware paper made from Kentucky hemp was, for economizing and cheapening it, occasionally mixed with manila rope, and while increasing its strength, the great liability of this irreducible material to curl and twist made it a dangerous adjunct. I induced Mr. Van Benthuysen to make some experiments upon this manila at his mill, and he afterward assisted me to have these experiments carried out in another, of which he was not the proprietor. By boiling this hard, hair-like material in caustic lime for twenty-four hours, instead of four—the time used for other material—the result of this chemical cauterization brought the obstinate fiber to terms.

As I know but little of the processes of milling, I presume that you are but partially acquainted with the method of manufacturing paper. It is a simple process, yet one requiring finely adjusted machinery, great care and skill. The rope is old, for the reason that new rope would be too expensive, the strippings of riggings being more economical and equally as good. This old rope is cut into lengths of about 2½ inches, passed into a machine something like an old fashioned thrashing machine, with spikes on the surface of the cylinder and all around its casing, and is thus torn into shreds, so that the resultant product resembles a mass of coarse animal hair. This, dusted so as to rid it of the dirt that adheres to the fiber, is afterward put into large vats or a tight rotary iron drum, and, mixed with lime, is submitted to steam for about twenty-four hours. The contents of these vats are after this cooking emptied into what is technically termed an engine, but which is nevertheless an immense wash tub holding about 800 pounds. This mass is rotated by the movement of a cylinder placed horizontally on one side of it, the surface of which resembles a steel washboard, which runs close down upon an inclined plane that resembles another steel washboard. Between these two surfaces this floating rope is passed until the cooked, harsh, and wire-like hair material is mashed, drawn, and combed out into flattened filaments that separate into an infinitesimal fiber, finer than the finest hair. Chloride of lime is mixed with the material for the purpose of adding to its cleanliness and increasing the whiteness of its color. This soft and sloppy stuff, after being rinsed in water, is let down into a circular mash tub in which rotary arms are continually whirling, for the purpose of making a homogeneous mass, and is then pumped up into two separated boxes, in which are rotated separate cylinders of woven wire. This wire is the paper makers' bolting cloth, and the water with the floating fiber comes to the center of each cylinder. These rotating in the pulp carry it upward and out of the water, the pulp being sucked against the face of the wire by the lowering of the water through the center of the cylinder and below the surface containing the pulp. The suction thus produced draws the fiber interlaced in every way against the rotating cylinder, which carries it upward in the shape of pulpy sheets as tender as and looking like cream, against a flannel belt, which picks it off as it passes over, and leaves the surface of the cylinder clean. The other cylinder, rotating in similar way with similar pulp, going through a similar experience, does just the same thing. Another belt of flannel carries this other sheet a short distance, when the two are brought in contact, and the spongy, adhering sheets are welded together, and carried farther under and over broad cylinders filled with steam, each about three feet in diameter, that squeeze out the moisture, and dry the sheet as it progresses. When it is solid enough to "go alone," the flannel belts leave it, and it passes under and over additional heated cylinders that squeeze out more and more water, and dry it so that at last it receives its collegiate polish at the end of the machine, and is rolled up into rolls of about two miles in length, and weighing from 400 to 500 pounds, a completed, tough manila paper. This is the pure rope paper for millers' use. Adulterants lower its quality and cost. At first this paper for bags was cut into sheets, folded by hand, and pasted by hand for the market. The original paper sack of this material was a very clumsy, corner-projecting, and obstinate package to tie. I was fortunate enough to be the first to devise a method by which the corners of this primitive form of sack could be removed, and a bottom constructed that was rectangular, with a double thickness of material to add to its strength at the point liable to abrasion in transportation. The rigidity of the paper, which necessarily resulted from its strength, yet was objectionable in tying, was reduced into a partially flexible condition, making it easy to close, by a very simple mechanical contrivance to corrugate it. This removed one of the greatest drawbacks to the use of this form of package. To-day all these processes are attained by machinery, and 150 sacks per minute is not considered an extraordinary mechanical product. It was not personal skill, or any special ability of contrivance, but the inexorable demands of the trade in the requirement of the package, that pressed my attention in the direction of contriving mechanical means to do quickly and well that which had been previously clumsily done by hand. So in claiming the parentage of the bag machines now in use in the United States, I simply aver the old adage, that "Necessity is the mother of invention."

The consumption of paper flour sacks in the United States is very close to 100,000,000 per annum. The consumption of cotton sacks is about equal in quantity. The burlap bag, of comparatively recent use for flour, is an old vehicle for the conveyance of wheat. California consumes annually somewhere in the neighborhood of 33,000,000 of these burlap bags. The total manufacture of this material in the United States is less than 1,500,000, and this is fabricated by convict labor on the Pacific coast, where the jute, of which this package is made, is easily procured from Hindostan, where it grows. Scotland is the only other producer of burlap to any great extent. There are 100 mills in the vicinity of Dundee, many of them a century old, that have been devoted to the fabrication of this coarse East Indian grass into the sacking in use in different parts of the world. Pesth, in Hungary, consumes about 7,000,000 of jute export sacks, filled by its millers for shipment largely to the English market. Jute is a difficult material to handle, and has to be woven in grease. Fish oil contributes the largest element, and the coarser and cheaper fats, not even removed one step from an obstructed funeral, are used to lay its fiber to enable it to be spun. This gives this fiber the peculiar odor that characterizes it, which is but partially expelled by the heat of the mangling irons run over its surface for the double purpose of flattening the meshes and producing a presentable appearance.

With the growing scarcity and the increased price of timber in the United States, it is evident that in this, as in European countries, the woven or the paper fabric will displace the wood package. Cotton is beyond question the cleanest and most superior form. The only objection that can be brought against it is its expense. The ideal package of the future will be and has been already successfully made—an unbleached fabric retaining the full strength of the fiber, and filled instead of bleached, to prevent the sifting through the meshes that characterizes its unbleached condition. This package, while not as white, and therefore perhaps not fully as presentable as the bleached bag, retains every element of strength with the additional advantage of being a non-sifting vehicle for the transportation of flour to our market. It costs little less for construction, and will I believe be the bag of the future.

There are some prejudices, although unwarranted, in the use of the paper sack for the transportation of flour for very long distances. This prejudice has arisen from two causes; one is the inferiority of the material under the general pressure and demand of lower prices, stimulating adulteration, or the speedy and therefore cheaper production, involving deterioration and brought about by a demand for cheapness and the anxiety to secure a possible profit. Manila paper is made to-day into sacks, and used by the million for the transportation through long distances of cement up to 80 pounds weight carried in the size of a one-fourth barrel sack. The strength to resist such a weight and such abuse as such a mass is subjected to is attained by extra weight of material and the greatest care in the production of the paper. An inch ribbon of this paper will hold up 100 pounds dead weight the stronger way of the fiber and 60 pounds dead weight the weakest way. It is stronger by far than leather of same thickness and width, and so far as tensile strength is concerned, stronger than the same weight of cotton drill. Such a package, however, lessened in cost, yet increased in strength by the total absence of bleach, is nevertheless more costly than the ordinary priced and lighter one-fourth barrel sack. Such a bag, however, if used for flour, is impervious to the air, dirt, all odors, and repellent of moisture under considerable exposure, and can be made so as to transport 50 pounds of flour from the Pacific to the Atlantic coast. Even a package of this kind would be two-thirds cheaper than the barrel; more than a third cheaper than cotton. In the earlier years of the exportation of flour from the Pacific coast, a very large amount of this kind of package was used by San Francisco millers for transportation around the Horn to Liverpool, being barrier against the odor of bilge water, which it was supposed would affect the value of the flour in the European market.

The romance of the old milling days, the splash of the lazy water wheel, and the glad babble of the released brook, the gathering of gossipy customers discussing month-old events, is forever gone. Romance is dead; it was not romance when living. The lauded "good" times, like the tints of the rainbow, are only thus colored because beyond our reach. The swift forces of nature, coerced to service by human intelligence, have woven together with wire and rail, and the sea shuttles of steam, the remotest lands of the planet. The struggle for human comfort, and "the pursuit of happiness," is no longer between men, but between peoples. It is no longer a contest of neighbors; it is a contest of nations. The injection of fresh discoveries, the development of new lands, like the thrown stone in a still lake, spreads the widening circles of its waves, and washes all shores. The Pennsylvania oil geyser lights the pagodas of Hindostan, and the valley of the African Congo is now being planted by ex-cannibals with American cotton seed. The East Indian government, under a five per cent. guarantee on the investment, is gridironing the base of the Himalayas with railroads that freight swiftly and cheaply their hitherto unsalable wheat. The output from Bombay has grown from nothing to between 30,000,000 and 40,000,000 bushels. You, gentlemen, know its quality, and while not of the best, it pushes by, crowding our good grain out of the market. Australia has joined Russia in feeding the world, and now the Argentine Republic reports 35,000,000 bushels of wheat as its annual export.

Every year the competition in the European markets grows closer, and the fluctuations of glut and sparseness sharper, quicker, and more uncertain. The evident one-sided English anxiety to gain control of our valuable markets is probably prompted not so much by a feeling of philanthropy as of selfishness. It reminds me of an incident I heard of, where two darkies, one old and somewhat feeble, the other a robust and healthy fisherman, were sitting together on the slippery edge of a deep water hole, when by some accident or stupidity the younger one fell in. In a moment the gray haired African plunged in and with an effort rescued his companion, and brought him soaking to the shore. A spectator who hurried to the scene complimented the elder upon his courage and devotion, saying: "I suppose this young fellow is your son?" "No, massa; he's no boy of mine." "Your nephew, or some relative?" "No, boss; no relative, no kin." "Well, it was kind of you then, under these circumstances, to risk his rescue." "Well, you see, massa, he couldn't swim. I didn't care so much for the nigger, but to tell you de trufe, de reason I went after him was dat he had all de bait." It is pretty evident that the United States, to-day, is to the European philanthropist simply the darky that carries the bait.

We have but one positive and unshakable grip on a market, and that market is our own. Political wisdom is that which will nourish and widen it and increase it by the shrewd policy of fostering diversity of industries, and attempting the possible balance of consumption and supply. This republic is and can be the most self-contained of any country on the planet. Its vertebræ bristle with all the minerals. The prairies drape it with golden grain. Torches of natural fire belt the continent with a girdle of inspiring light. Columbia, loftier than any statue of liberty, touches with one hand the glaciers of Alaska and with the other plucks the unfrosted fruits of the tropics. Sixty millions of people gather daily at her table. It is these that you are called to feed. Is it not wise, and well, to care for those close to us, whose dollars spinning around the board, from finger to finger, come back to the starting hand?

Now, with the flavor and shaping of a benediction, let me say that the beneficence of your guild was sung by the first and oldest poet in the world. Homer, as he touched his barbaric harp, and turned his sightless eyes toward the Olympian heights, sang:

"The mills of the gods grind slowly,
But they grind exceedingly fine."

* A paper read before the Buffalo Convention by Senator Arkell, June, 1888.—*N. W. Miller.*

A QUICK STEREOTYPING PROCESS.

A NEW stereotyping process is described as "almost as quick as lightning" by the *Paper World*. As a matter of every day labor, the "starter," or the number of plates required to enable the pressmen to begin work on the presses, is completed, ready for the presses, in seven and one-half minutes, and thereafter two plates a minute are turned out.

The means by which this extraordinary feat is accomplished are interesting as showing the wonderful improvements in one of the mechanical arts within the last year. Stereotyping is one of the newest of the important arts of the world. In 1850 Kronheim & Co., of Paris, invented the papier mache process, which is the process of pressing a wet, thick, soft sheet of paper into the face of a form of type so as to form a paper matrix of the type. Then this matrix is put into a mould, and melted type metal is poured in, which, when cooled, forms a plate ready for the press.

Until within a few years this paper matrix was built up by pasting several sheets of paper of different qualities together, the inner sheets being somewhat like blotting paper, and the face that was to go against the type very tough and of fine quality. Now a paper is made especially for the purpose, and sold to the publishers in sheets of the size of the pages of the newspaper.

The first to try to introduce the stereotyping process to newspaper publishers was a man named Duncan, who came over from London in 1856, hoping to find America more appreciative than British publishers. He failed because the circulation of American papers did not demand such an innovation, the Hoes having just turned out their first lightning press. It used type, and there was no real need of plates.

A year later, however, the circulation of the London *Times* had advanced so far that the publisher was obliged to set the forms in duplicate, using two of Hoe's mammoth presses. The great cost of a double force of type setters made the manager ready to listen to an innovator. At that time James Thompson was foreman of the London Newspaper Stereotyping Company, a concern engaged in selling column plates of news to country newspapers on what is now called the patent plan. The *Times* investigated Mr. Thompson's methods, and adopted them, first for the advertisements standing over from day to day, then for whole pages of advertisements, and, finally, for the entire paper. It was considered a triumph of human ingenuity when the work had been so far perfected that two plates were turned out complete in forty-five minutes. The paper did not get to press so early by that forty-five minutes, but the publishers had saved the cost of setting the type in duplicate. The adoption of the system by the other papers of large circulation followed as a matter of course, for even if they did not have to set their type in duplicate, they saved enough in the wear of type to justify the expense, not to mention other advantages of plates, such as the ease with which extra copies can be printed as wanted.

In the early days a matrix which would stand the casting of two perfect plates was considered very good, and one enterprising publisher of New York offered a substantial reward for any one who would produce a matrix that would yield six perfect plates. Now, by a secret chemical process developed by Mr. Thompson, a matrix is made that will turn out sixty plates if needed.

But the most important improvements relate to those parts of the work which consume time between the moment of receiving the type form and the handing of the completed plate to the elevator man to be carried to the press room. Formerly, with a good many motions, consuming much time, the paper was beaten into the interstices between the type with brushes; but now, by the new process, when the form is shoved on to the bed of the moulding press, the type is oiled as before, the prepared paper is laid on, a blanket is laid over all, and the form and bed are rolled between two heavy iron rollers that do in thirty seconds the work which took two men with brushes six or seven minutes to perform.

From this press the form with the matrix on goes to a drying press as before, but, what with steam below the bed and gas jets in the platen, it remains in this press only three minutes.

The matrix is now taken off. It is steaming hot, but stereotypers are the modern salamanders, and do not mind a little matter of handling things heated up to 212 degrees Fahrenheit. From this press the matrix goes to a scorching table, which is one of the important improvements made by Mr. Thompson. It is simply a flat iron table with gas jets beneath which heat the table to a scorching temperature. The matrix is laid back down on this table and covered with a thick asbestos cloth blanket. It remains there while a man may count thirty, and then it comes out done to a turn. Every particle of moisture which remained in it after the drying in the steam-heated process is driven off, and it is simply crispy dry as well as scorching hot. The stereotyper grabs it from the table, and goes on the run to the moulding box, where the cast is to be made.

The casting box consists of two curved iron plates, with shoulders on that shut together in such a way as to hold the matrix against one of the plates and leave space between it and the other plate, so that when the type metal is poured in, a plate of the right thickness is produced. The box is curved because the plates must be curved to fit the cylinders of the press.

It is when casting the plates that the advantages of Mr. Thompson's scorching process are seen. Take as much care as he would in the old way of drying without scorching, the matrix came to the casting box moist, and the first cast was chilled by the moisture and spoiled. As a matter of fact, two casts were generally required to heat up and dry out the matrix. Now, if the man who brought the scorched matrix to the box should stop to blow his fingers to cool them, two others might shut the matrix in the box, pour in the metal, and turn out a completed plate while he was giving his fingers three good puffs.

The solidifying of the metal as well as reducing the temperature to a degree where the plate may be handled has always been done by means of water, formerly by pouring water with a dipper over the convex side of the casting box, but now Mr. Thompson has placed several perforated gas pipes in the concave side of the casting box, and has connected them by means of a hose with the waters of Croton Lake. A valve is opened and a flood pours through the perforated pipe, cooling all parts of the box at once, and in a fraction of the time required by the dipper process.

The metal used in making stereotype plates is composed of tin, lead, and antimony. If kept at a proper temperature it flows like water, and is perfect for its purpose. But in the melting pots of the ordinary stereotyping rooms, the metal is not always kept at just the right temperature. This is due to the fact that the pot, set in a brick furnace, has the heat applied to the bottom of the pot only. But the new melting pot is unquestionably the best in the country—probably it has no equal in the world. The fire is below the pot, as in other furnaces, but the heated products of combustion, instead of passing directly away to a chimney, must first wind completely around the pot in a spiral tube until they reach the very brim of the pot, when they pass away and up a stovepipe that is 106 feet high, to insure a good draught. Thus the metal is heated at the bottom and on all sides, and is just right when wanted.

RISKS AND APPLIANCES OF FLOUR MILLS.*

By E. W. ARNDT, of Depere, Wis.

EIGHTEEN years in a flour mill, and that during the transition period when old methods and appliances were forced to give way to the new, and the modern mill of to-day grew to be the old style mill of to-morrow, could not but have given me some insight into the increased hazard of the business, wrought by these changes, and has turned my mind to ways and means of reducing to a minimum the conditions favorable to the starting or spreading of a fire.

In the old mill, where the operations were confined to cleaning the wheat, reducing it to flour, bran, and shipstuff by the one simple application of our old friend, the millstone, and the separation of these materials by the old-fashioned bolting reel, the machinery was not complicated nor crowded. The speed of any shaft seldom exceeded 100 revolutions, and as we all know, the old mills seldom burned, and such a thing as a flour dust explosion was known to but few.

You who were in the business twenty years ago can remember when the companies who now ask four per cent. and five per cent., and often will not insure you at that, willingly accepted two and one-half and three per cent. Can we say that our flour mills have not grown more hazardous, or that it is the unreasonableness of insurance companies who have combined to extort from us rates that are greater than the hazard of our mills demands? I think their position was forced upon them by continual losses on flouring mills, to meet which they from year to year advanced rates. The trouble was, they did not meet it in the right way. They established an arbitrary schedule which they applied without a proper regard to the hazard of each mill, their only object seeming to be to make the flouring mills, as a body, make good their losses on flouring mills. The result is that they still continue to lose money on this class of property.

But there was a way out of it that the millers discovered themselves, and that it was a success is evinced by the results shown by the Millers' National Insurance Company, and the millers' mutual insurance companies of Illinois, Iowa, Minnesota, Michigan, Wisconsin, and other States. They have established the fact that flouring mills can be insured as cheaply as in the days before rolls, purifiers, and dust rooms were known. How is this done? Is it a secret? Yes; an open secret. It consists in insuring mills that come up to a certain high standard, which is not established by the application of a cold-blooded schedule, but by a system of inspection, thorough, full, complete; an inspection that enters into every detail of the business, into every dark corner of the mill, discovers dust piles, hot bearings, concealed bearings, and dangerous machines. Look at one of these inspectors as he emerges from a mill where he has spent several hours. Does not his suit of overalls and jacket of duck covered with flour dust indicate that he has been "through the mill," and not over it?

There are hundreds of mills for which no adequate rate can be obtained. The application of a schedule would rate them low, but a thorough inspection would reject them. I consider that the success of these mutual insurance companies depends more upon the frequency and thoroughness of their inspections than upon anything else. When these inspections were commenced, there was an inclination on the part of mill owners to resent such searching inquiries, and inspectors were put down as fault finders who did not know their business. But of late this has changed; their presence is welcomed, their opinions respected, and their suggestions quickly complied with.

These mutual insurance companies are sometimes styled protection companies, because they adopt as part of their work the improvement and protection of the property they insure. Let us hastily glance at some of the improvements originated and brought about through the work of these inspectors and the companies they represent, though I would not give to them the credit for all such improvements.

That "cleanliness is next to godliness" is an old adage, the force of which at one time seemed to have been forgotten by our millers. It was as hard to convince them that a lack of cleanliness was in any way a menace of danger from fire as it is to convince the average man that a lack of godliness threatens him with the same danger. But even this obstacle has been overcome, and to-day the successful mill is a clean mill.

Elevator heads have been changed so that the strut board is inclined and the heads made self-cleaning. Conveyors have been provided with automatic traps or doors at the point where they discharge, and those not in use disconnected or taken out. Open lights have been abandoned, and inclosed lanterns have been adopted for lighting, metal cans provided for greasy waste and rags, and barrels of salt water and pails have been introduced on every floor. Axes and bars are arranged conveniently. Many dangerous machines have been discovered and the points of danger remedied, while the attention of the manufacturers of these machines has been drawn to the defects, and they have changed the construction so as to obviate the danger. These and many more changes have been brought about, all tending to decrease the hazard of flour mills.

While this work has been going on, inventors have given their attention to the matter of taking care of the dust from purifiers and wheat-cleaning machines, and to-day we have a variety of machines that accomplish the work satisfactorily, leaving no excuse for the mill that still depends on the old-fashioned cloth dust room.

Out of these, and influences equally potent, has grown the roller mill of to-day, not yet perfect, not yet free from faults, whether viewed from a financial or an insurance standpoint, but still a vast improvement over the mill of ten or even five years ago.

Can I describe such a mill? No; not fully, for there is much that I do not know, but I can give you some points in regard to construction that may be of use to you. Let me picture a mill where, in building to obtain as good results as are possible from an insurance standpoint, none of the essential qualities of a good mill from a financial point is sacrificed. Let the mill be 100 to 200 bbls. capacity. As to the building, I do not agree with the insurance man who asks us to build our mills low and charges us for each additional story over two. I claim that a mill of large capacity that is not over three stories high is a dangerous mill, because of the fact that so much more machinery is necessary, so much more elevating and conveying in order to handle the stock; that while the building may be more accessible in case of a fire, the liability of a fire being started by friction, or any defect in the machinery, is very much increased.

Compare such a mill with one of our more modern structures. The stories of these old mills are generally low, and the machinery necessarily crowded, where you have to either squeeze through or dodge under as you make your way over the different floors. Notice the great number of countershafts, short elevators, and long conveyors; consider the large number of bearings, many of them partly concealed, or located at inaccessible places. My conclusion is, that the height of the building needed for the convenient location of the machinery and the handling of the stock should not be sacrificed to the one point of a low building because of convenience of access at a time of fire. So I would construct it of three stories and a basement. I would make them of the following heights: Basement, 10 feet; first, or roller floor, 12 feet; second, or purifier floor, 12 feet; third, or bolting floor, 20 feet.

If built of brick or stone, the walls should be heavy and ledged for the timbers, or if the ends of the timbers or girders are let into the walls, the ends should be beveled, and cast iron sockets of like shape laid into the walls to receive them. This will prevent the walls being torn down by falling timber in case of fire. Joists should not be used for stringers, but the girders placed sufficiently near together and covered with plank three or four inches thick, according to the weight to be supported. This plank should be dressed on both sides and grooved and tongued. If desired, another floor can be laid on top of this.

The advantage of this kind of construction is that the under side of the floor presents a smooth, unbroken surface between timbers, that can be whitewashed and will long resist the action of fire. The objection to a joist floor is that the joists are but hiding places for dust and dirt, and they afford the necessary kindling wood in case of a fire, giving every encouragement to its spreading.

In providing for wheat storage, I would say that all wheat should be stored and cleaned outside of the mill proper, and only brought in when it is ready for the rolls, but where it is deemed necessary that wheat should be stored and cleaned in the mill, I would put all of the cleaning machinery in the basement, and construct the storage bins in the end of the mill farthest from the bolts and purifiers, building for them a foundation of their own, inside of, and separate from, the foundation of the mill. This will obviate the danger of putting the shafting out of line by alternate loading and unloading of the bins. In the arrangement of the machinery, I would, as nearly as possible, place the bolting reels and centrifugals on the upper floor. The main line of elevators should be at one end of the building, about three feet from the end, extending from the basement to the top of the upper floor. But few elevators outside of this line will be needed. The heads of the reels should of course be next the elevators.

On the next floor below, or the second, should be the purifiers, arranged with their heads toward the tail of the bolts above them. On the next floor below should be the rolls, in line with the elevators. The break reels and flour chests should be on the purifier floor. There will need to be three prominent lines of shafting all running parallel with each other, a roller line in the basement, a purifier line on the third floor, and an elevator line on the upper floor. Gears should be avoided and an upright shaft never used. A mill thus arranged will be light and airy, open to the inspection of the miller as he makes his rounds, easily kept clean, and all bearings will be easy of access.

The stock as it comes from the breaks is elevated to the highest point, and by its own gravity falls from machine to machine without intervening elevators or conveyors, until it reaches the rolls and is by their action reduced still further, when the operation is repeated. I have in mind a mill built in a general way on this plan. It is a first-class mill, doing first-class work, though only of 100 barrels capacity. There are only three elevators outside of the main line referred to, and but two pairs of gears, outside of those on the bolts and purifiers, one of those being the large pair of bevel gears on the top of the water wheel shaft. There is only one conveyor in the mill, four feet long, in addition to those under the reels and purifiers.

There are other details I should advise: A dust collector of some approved pattern on the top of every purifier. Dust collectors for the wheat-cleaning machines, and one, with a suction, for the rolls and stones, if the latter be used. All elevator heads should be hoppered, and all conveyors provided with a valve or gate, at the point where they discharge, held closed by a spring, so it will open if the outlet is choked, and close automatically if relieved. The shafting should be heavy enough to prevent springing, and provided with long bearings. Pulleys should be large enough to prevent slipping of belts. Avoid the use of wooden pulleys in elevator heads (iron flanged pulleys are best), and, if used for driving purposes, see that their edges

* Read at the Buffalo convention.—*N. W. Miller.*

or sides do not come in contact with elevator legs, posts, or other wooden surfaces. Disconnect all conveyors not in use, or take them out, as an unused conveyor, if left running, is a source of much danger.

Right here, a word about the construction and use of fire-proof doors and shutters will not be out of place, as where steam power is used there should be a fire-proof boiler and engine house, with all the openings into the mill protected with fire-proof doors. The best fire-proof door is made as follows: Use two or more thicknesses of tongued and grooved, thoroughly seasoned pine boards. Lay them diagonally across each other and nail them firmly together with wrought nails, well clinched on the opposite side. Cover both sides and edges with the best quality of tin, put on with a lock lap, and nailed under the locking of each joint with barbed wire nails, one inch long. The tin must be made to fit the exact form of the door, so as to leave no air spaces. Where practicable to use them, the sliding door is preferable. They should be hung with wrought iron hangers, bolted on the doors, and wrought iron track bolted through and through the walls, with a guide track below the level of the floor, and should close in a rabbet so as to hold the door in place when shut. The size of the door should be from two to four inches larger on each side than the opening. In case hinges are used, they should be of wrought iron, extending the width of the door, fastened by nuts and bolts, and hung on wrought iron hooks, firmly embedded in the wall. The latch also should be of wrought iron, bolted through the door. Fire-proof shutters should be of the same general construction. This kind of door has been proved to be the best. They will stand an immense amount of heat for a great length of time without warping out of place, as is the case with doors or shutters made of iron.

I have thus given you very briefly, and in rather a wandering manner, a few ideas about the construction and care of flour mills. I doubt not you have all heard it before. I have advanced nothing new. But yet I find in my experience in insuring and inspecting flour mills that old and well-known things are neglected. Familiarity with any danger creates a contempt for it. By the application of this rule we always find that a miller has but a very limited sense of any danger in his own mill, though he sometimes does admit that there is some probability of his neighbor's mill burning. So I would urge you not to depend too much upon your own sense of security. Remember your business is to make money out of the mill, and in these days it takes a concentration of all the energy and wisdom a man possesses to accomplish that, leaving but little time to the thought of how to prevent fires in a mill.

The best plan is to put your mill under the fostering care of some good mutual insurance company, being sure that if their inspectors discover any defects, you should give heed to them. In this way the companies become, as it were, copartners with you, to the extent of your danger from fire, and are interested with you in removing all chances for a conflagration. Remember that as the standard of your mill is improved, the cost of your insurance will diminish, and that your interest will be in the future, as it has been in the past, to sustain these companies.

FIRE APPLIANCES.

Before closing I desire to say a few words about fire appliances in flour mills. If I were confined to but one means for extinguishing fires, I would choose our old stand-by, barrels and casks of salt water, with a plentiful supply of buckets. This contrivance needs no skilled hand to bring it into use. There is no hesitation, no questioning. We all have an inherent instinct that teaches us how to use a bucket of water in case of a fire. Objections urged against them are that the water freezes in the winter, and the pails are always missing when wanted. Let me tell you how to avoid these troubles. In preparing the brine, take a barrel one-third full of salt, to which add about one pound of common washing soda; fill the barrel with water, and you have a mixture that will not freeze nor become offensive, one pail of which is worth a dozen pails of water for extinguishing a fire. Keep the barrel covered. To prevent the pails being carried away, put them on a shelf over the barrel, then take a short piece of rope, nail one end to a post or the wall, passing the other end through the handles and nailing it securely also. No one will take one of these buckets for any purpose except in case of a fire, but when needed a vigorous pull will release them. The buckets should be of galvanized iron, or what is known as a paper or fiber pail. The hoops will fall off from one of the old-fashioned kind, if left in a dry place any great length of time.

I attach great value to a stand pipe and hose, if the pump is efficient, always ready for use, and a proper arrangement of hose provided, in all classes of mills and manufactories, but least of all in a flour mill. My conclusions are drawn partly from observation and a knowledge of such protection being of little or no use at the time of a fire. I know of no class of risks where it is so necessary to be able to use the appliances at hand, without delay, as in a flouring mill, one minute's time lost often turning the scale. A mill is built for the automatic circulation of the stock, and following the line of that circulation, though it is confined in elevator legs, spouts, reels, and other machinery of the mill, is a cloud of dust. Let a fire once start in that line, and we see why it is almost in an instant issuing from every part of the mill. In such a case as this, a stand pipe and hose can be of but little use. If they are used, I would advise that the hose be of rubber-lined cotton, and not over an inch and a half in diameter. At least 50 feet should be attached at each floor, with nozzle. I would not put it on a reel, but prefer a swinging bracket shelf, with the hose laid in layers. Do not use a common globe valve, as there is often delay in opening it. It may be turned the wrong way, may stick, or may be but partly opened in the excitement of a fire. A better contrivance is a lever valve, which can be grasped the instant the nozzle is taken, and without any delay or mistake opened as the man runs with the hose. I find that many flouring mills are burned without the stand pipe and hose being brought into use, chiefly because the millers and employes are afraid of dust explosions, and leave the premises without delay upon a fire alarm being given.

I attach but little value to hand grenades, glass bottles of salt water, and such contrivances. I have seen some very good work done with them at an exhibition, but they seem to lose their efficiency when most needed, and generally prove a broken straw to lean upon. I think a full system of thermostats would be valuable in a mill. My opinion is that a large number of fires occur from hot boxes, even where the cause is unknown. How many mills are reported as "all right when shut down at six or twelve o'clock at night, but the fire broke out shortly afterward." I have a large number of such records. You are aware that a hot box will remain hot and seem not to be at all dangerous, until the shaft is stopped, when it will blaze up. I have seen this many times. I would arrange a thermostat at each bearing. I would put them in with a closed circuit so that I would be sure that every thermostat was in working order. On the lower floor, I would put an indicator and an alarm, which would show the location of the hot box, and continue to sound the alarm bell, until the evil was remedied. This plan would not be expensive, and I think would prevent many mills from burning, by giving timely warning of hot boxes, and would thereby remove one of the prime causes of fires in flour mills.

The value of automatic sprinklers in a flour mill is a subject now being much discussed. My opinion is that a thorough system, up to the New England standard, of some reliable sprinkler, placed in a flouring mill so as to thoroughly cover every point, will give undoubted protection. The fact that mutual insurance companies are making concessions in rates, equal to twenty-five per cent., where such equipments are put in to their satisfaction, is evidence of their opinion. But let me ask you here not to be misled by the mere name of automatic sprinkler, lest to your sorrow you may some day find that what you supposed to be efficient protection was but a delusion. There are a number of good and reliable sprinkler heads in the market, but the manufacturers, or their agents, in their efforts to close contracts for the equipment of manufacturing plants, let their zeal run away with their judgment and induce their customers to put in equipments that come far short of being standard. They are deficient to such an extent that the mill or factory so protected is but little, if at all, improved as a fire risk, and the owner not entitled to any reduction of rate because of his outlay.

This is all wrong, and any one contemplating the introduction of automatic sprinklers should insist upon their coming up to the requirements of the mutual insurance companies. Expert inspections of automatic sprinkler risks in the West, put in during the last year, show fully three out of every four as being entitled to no reduction in rate, because of the deficient equipment, and yet, with this unreliable protection, we often find the manufacturer neglecting every other precaution and placing entire dependence upon his sprinklers. I cannot state here the full requirements of an automatic sprinkler equipment in a flour mill; the details are too extensive to be shown in a paper such as this. I would only repeat what I have before suggested, that, as it is chiefly upon the mutual companies you are to depend for concessions in rates, you be sure that your automatic systems come within their requirements. They keep in their employ expert inspectors who are competent to detect any deficiencies in the work, and give you the benefit of their experience. It would be well for you who contemplate equipping your mills to consider this.

GLAZES FOR PORCELAIN WARE.

MM. LAUTH and Dutailly have recently communicated to the French Chemical Society the results of their investigations on the red glazes which are produced on porcelain by means of copper and its salts. The color produced in this manner is of a much more permanent nature and of a far superior tint than that which is obtained when oxide of iron is used for the same purpose. This red color, when used for decorative work on ancient porcelain, is often accompanied with a blue coloring matter beneath the surface of the glaze. It appears that the secret attached to the production of these colors was known only to the Chinese until recently, and that the red, known as Tsi-houng, or *sang de bœuf*, could not be imitated by the French at the porcelain manufactory at Sévres. In 1852, MM. Ebelmen and Salvetat endeavored to reproduce these copper colors in France by making careful analyses of fragments of Chinese procelain colored in this manner, and then imitating, in the composition of the glaze and clay employed, the Chinese specimens. The results of these earlier experiments are now in the ceramic museum at Sévres, and are the first examples of the kind produced in Europe. Other French chemists have since then attempted to improve on the first trials, and the problem has also been attacked by H. Seger, of the Berlin Porzellan Fabrik, and by H. Bunzli, at Krummnus, in Austria. MM. Lauth and Dutailly have established by their experiments that the maximum temperature which the Chinese red glazes can stand without losing their color approaches to that used for baking the new Sévres porcelain. By successively associating all the compounds capable of entering into the formation of a colorless glaze with oxide of copper, they have come to the following conclusions: That in the same series of glazes, those which produce the finest red color with copper compounds have the greatest amount of silica present, and that in a series of glazes of approximately the same degree of acidity, the best results are obtained when there is a large proportion of alkalies and a small percentage of alumina. They have further noticed that if the alkaline metals be increased in relation to the alkaline earths present, a finer red is produced, but at the same time the liability to break is increased. By employing boracic acid or borates this inconvenience may, in some measure, be prevented. Lime, magnesia, various fluorides, and lead and iron oxides have also been tried; but the results obtained by their use have not proved satisfactory. A very good red glaze can be produced when zinc oxide and baryta are the bases present in the glaze. The copper can be introduced into the glaze in different ways. Oxalate of copper, simply mixed and not fused with the melt, gives good results; but if previously fused with the glaze, very satisfactory colors are produced. The quantity of copper salt employed depends on the time required for baking the porcelain, and also on the temperature of the furnace. Five per cent. is the quantity which is recommended as the most suitable to use, and the addition of a small quantity of tin oxide is advantageous. The glaze which has given the best results has the following composition:

Pegmatite, 31·17; sand, 36·37; fused borax, 12·96; dry carbonate of soda, 4·76; barium carbonate, 10·39; zinc oxide, 4·33. Corresponding to silica, 61·03; alumina, 5·85; alkaline oxides, 10·72; baryta, 8·42; zinc oxide, 4·51; boric acid, 9·48. This glaze has a degree of acidity represented by the number 5·39, that of the French glaze, No. 1, being 5·14. The bases are in the proportion which corresponds to the formula:

$$Al_2O_3,\ 3NaKO,\ BaO,\ ZnO.$$

By using this glaze with a similar one containing lime, MM. Lauth and Dutailly have succeeded in obtaining a great variety of colors on the same material, and in producing some effects on porcelain which have not hitherto been achieved.

HOW BANK NOTES ARE MADE.

IT can safely be said that not one out of 100 people who handle bank notes knows how much trouble it takes to make them. The "making" in this case, of course, is understood in the sense of producing the attractive specimens of the engraver's art in green, orange, and black. Otherwise the "making" comes quite easy, far more than the average citizen is aware of. Even the more or less crude work of the counterfeiter is the results of laborious and painstaking efforts of many weeks. In detective stories one is wont to read that artists of the highest standing frequently lend their genius to the production of the "queer," but this is indignantly denied by the legitimate artists.

"During my long career I have heard of but two or three good engravers who had anything to do with counterfeits," said L. J. Hatch, formerly of the government Bureau of Engraving and Printing, and now connected with the Western Bank Note Company. "The good engraver would scorn to engage in such work. His standing as an artist and a citizen is too high for that sort of thing. Moreover, I do not think that there is any one artist who combines in his person the aptness for the three great specialties of bank note work—the lettering, lathe and scroll work and picture engraving. Especially the latter specialty is one in which the height of art is reached by but few. In fact, there are not more than six or eight proficient artists in the line of bank note picture engraving in this country, and their services are so well paid that they would be worse than fools to throw their talents away in criminal pursuits. The bank note as you see it—of course I speak of the design only—is not the work of one endeavor, but of four to each plate at least. Each artist engraves a part of the design, and the different parts or dies are united to one plate by an intricate and delicate system of transferring."

One can readily gain an idea of the minuteness of bank note work when it is learned that it takes a good engraver from twenty to thirty days to complete the vignette—portrait or scene—alone. Take for instance General Grant's portrait in the vignette of the $5 silver certificate, the counterfeit of which is just now the talk of the city. A careful scrutiny by means of a magnifying glass will disclose that the work, which upon first glance impresses one as the result of miniature portraiture in ink, consists of a multitude of delicately engraved lines and dots, which can only be produced by the aid of a magnifying glass.

"Each portrait requires a different combination of lines and dots to harmonize with the features of the man portrayed," continued Mr. Hatch, speaking in the Chicago *Herald*. "There is no system of portrait engraving. If an artist would attempt to employ a settled method, he would distort the features. In fact, each engraver puts his own individuality into his work, and his production is as characteristic of him as the signature is of a writer. So much is this the case that one engraver in this line will be able to tell the work of another at a glance. For this reason the counterfeiter encounters insurmountable difficulties in copying a vignette, unless he discovers some mechanical method, like photographing, litho-engraving, or electrotyping, and these aids of the counferfeiter are, of course, at once apparent to the expert. The counterfeiter who copies a portrait by hand cannot keep his individuality out of the work.

"Picture work requires the highest grades of engraving. The artist has not only to produce light and shade, but he must understand how to harmonize lines in order to obtain what is called a 'speaking likeness.' In this respect the engraver's art is not unlike language. You may express the same idea in different words which expresses the idea exactly, beautifully, not a word too much nor one lacking. Thus there is but one harmony of lines and dots which makes a correct portrait. To copy such portrait by hand without the copyist being able to transplant himself into the creative individuality of the original artist is preposterous. That is the reason why the inferiority of a counterfeit is nearly always first observed in the picture work. Where there is one picture engraver, there is a handful of letterers."

Truly, the lot of a bank note engraver is that of a patient toiler. Day after day he plods away with his assortment of diamond pointed gravers, some of them as fine as the finest needles. Line by line and dot by dot he carves into the shining steel plate before him a miniature of the design to be reproduced. The days lengthen into weeks and the weeks into months before his work is finished, yet each line and dot is of his own creation, until all the minute carvings blend into one beautiful production—a speaking likeness of the design, and still so widely different in the execution. That part of the plate, however, is not the one from which the note is printed. The lathe worker and the letterer have been busy on their parts of the design while the portrait engraver was working, each artist working on a separate piece of steel. These pieces are hardened and form the die. From the latter the design is transferred to a steel roll of softer nature by applying an immense pressure, actually impressing the design of the die to the roll, on which of course the parts sunk in the die will be elevated and the elevations depressed. This part of the work, though mechanical, requires the greatest degree of nicety and exact adjustment of parts in the complicated machinery. Its results, speaking by comparison, are to a stereotyped matrix what a steel engraving of modern times is to an ancient woodcut. The steel roll, containing now what may be termed the

matrix of the note, or rather one side of it, is hardened in turn, and from the roll the design is transferred to a softer plate by immense pressure. The latter plate is the one from which the printing is done. Inasmuch as not more than from 10,000 to 12,000 impressions on paper can be taken from one steel plate, it is clear that numerous printing plates have to be made from the original engraving, which is known as the "bedpiece."

The plates used for printing are immediately destroyed when the impressions begin to show flaws. The "bedpieces" are preserved in a vault of the Treasury, and temporarily transferred to the Bureau of Engraving and Printing when it becomes necessary to make new printing plates. All this is done under the strictest supervision, of course, yet it has happened that wax impressions got into the hands of counterfeiters. These wax impressions have been treated with chemicals, known only to producers of the "queer," until every line, dot, and filament of the genuine original was transferred to the counterfeit plate. Of course, in such cases nothing remained for the government but to retire the entire series of genuine notes from circulation. It happens not infrequently that counterfeiters produce a small number of the "queer" stuff with obvious defects. Then, after the press or the so-called counterfeit detectors have called public attention to the faults, the latter are corrected, and what may be termed a revised edition of the counterfeit is issued in large numbers, more dangerous than the first issue.

Photography has seen its best days in counterfeiting. There are special points in each genuine note—notably the tints of different color—which the photographer cannot produce. But there are methods of operating on steel plates which expert counterfeiters know how to handle with great dexterity and no mean quality of workmanship. Two methods are especially dangerous because they produce the original design with such exactness that only the quality of the engraving—like in the recent five-dollar silver certificate—furnishes a criterion to determine whether a note is counterfeit or genuine. All this is, of course, said without reference to the quality and texture of the paper. For the experienced counterfeiter, especially if he works in smaller denominations of currency, the paper is not much of an obstacle. He knows how to "age" the bills so that they have the appearance of having been much handled. In the case of bills of smaller value, which are not very closely scrutinized, this artificial "aging" is usually sufficient to preclude detection.

One of the methods of transferring is by means of gelatine, on which the design is carefully copied and then transferred upon the etching ground by the usual process of acid baths. Another process, still more artistic and giving a higher degree of exactness, involves the destruction of the genuine note. The latter is fastened to the steel plate by means known to the craft, and then the paper is soaked off, leaving the design, slightly elevated on the plate, which is then subjected to the etching process, very much in the way the finer grade of electrotypes are made. Of course this counterfeit can be readily distinguished from the work by hand, but it takes an expert to do it. The general public is usually taken in until the counterfeit is exposed.

The professional counterfeiter rarely, if ever, places his own work into circulation. He sells to what is known as the "second party," and the latter in turn to the "shover" or "layer down." Experienced detectives claim that the "second party," as a rule, pays about thirty per cent. of the face for the "queer" stuff, and he in turn sells to the "shover" at an advance of from fifteen to twenty per cent. The "shover" generally travels in company with a "pal," who carries the bulk of the "queer." This is done in order that if the counterfeit is fastened upon the "shover," and his arrest follows, and no other counterfeit is found on his person, it relieves him in a measure from the suspicion of being a "professional." The prices paid vary, of course, with the greater or less degree of workmanship in the counterfeit, and so is the manner of circulation adapted to the circumstances. Smaller notes are pretty generally circulated without regard to unison in action, but if big bills have to be floated, arrangements are made by which the bulk of the queer can be put in circulation simultaneously—down to the minute—in every large city and in numerous places of each city. This is done to circumvent any telegraphic "pointers" sent from one city to another of the discovery of counterfeits.—*Daily Graphic.*

NEW APPARATUS FOR FILLING BALLOONS.

A SHORT time ago some experiments were conducted in Furstenwalde in the presence of many distinguished spectators with an apparatus for filling gas balloons. The new system promises to prove of special value to military ballooning, for which it is primarily intended, though applicable to other purposes. The value of aerial navigation in war time and under certain conditions is recognized by all. Its general introduction, however, has hitherto been attended by difficulties. To fill a balloon with coal gas is practically impossible in the field; so that hydrogen must be employed. Hydrogen has hitherto been produced by passing water as steam over glowing iron, or by decomposing a solution of sulphuric acid with iron or zinc. The former of these processes can only be carried out by experienced workmen, and necessitates the transport of large quantities of iron. The apparatus, moreover, is on such a large scale as to be almost too unwieldy for use. The second method also has its defects. In order to fill a balloon of 500 cbm., about 2,000 kg. of zinc, 4,500 kg. of sulphuric acid, and 39,000 liters of water (partially for mixing with sulphuric acid and partially for cooling) are required. This large quantity of sulphuric acid alone is cumbrous and dangerous to transport, the requisite water can only be obtained during war time in exceptional cases, and as the sulphuric acid of commerce contains a large percentage of arsenical impurities, the gas evolved contains as a rule so much arseniureted hydrogen as to be poisonous, and many deaths have actually taken place in consequence.

The new apparatus, invented by Majert and Richter, obviates these disadvantages. The hydrogen is produced by red-heating a mixture of slaked lime and zinc dust. The heat separates the water from the lime, the water being decomposed by contact with the zinc, giving off pure hydrogen. The mixture consists of a dry powder, which can be placed in tin boxes and is easily transportable. The gas evolved is free from poison and acids, and can harm neither the stuff of which the balloon is made nor the ballooning party. The retort looks like a small portable engine. It is mounted on a gun carriage, and can easily be drawn by four horses. In front is a seat for two drivers, which is screwed off when the operation is to begin, and a chimney substituted. These preparations last one minute. The fire is then lighted, and in six minutes the pipes which receive the powder are red hot. The powder is then placed on the pipes, and five minutes later hydrogen gas is being regularly given off. When 120 boxes of powder are utilized, about 120 cbm. of gas will be given off per hour, so that in three hours a moderately sized balloon can be filled. The experiments at Furstenwalde answered every expectation.—*Kuhlow's German Trade Review.*

THE DIRECT PRODUCTION OF PURE HOT AIR FROM COAL.

A DISCOVERY having an important bearing in the present upon the arts and manufactures, which may in the future aid in rendering the atmosphere of towns and cities purer than it now is, has recently been made by Mr. William A. Gibbs, of Gillwell Park, Chingford, Essex. The discovery is that perfectly pure air can be produced from the combustion of coal, and this discovery is mainly due to the circumstance that the production of air under such conditions was a desideratum, necessity once more asserting herself as the mother of invention. Mr. Gibbs is well known as having done so much for agriculturists by means of his harvest saving appliances, and still more lately for tea planters by his tea drying apparatus, all of which inventions have been described by us. Now, tea drying requires hot air, and to produce this, coke has hitherto been used, the deleterious vapors from which, of course, found their way into the atmosphere of the tea drying houses in which Mr. Gibbs' apparatus is employed. It was the desire of a number of tea planters in India, who have for years past adopted his process, that Mr. Gibbs should endeavor, if possible, to procure by simple means perfectly pure and innocuous hot air from the native coal recently discovered in Assam and from the waste wood abounding in other parts of India. Mr. Gibbs accepted the challenge, and during the past year has given his undivided attention to the task thus set before him.

The outcome of his investigations and experiments is a system of producing perfectly pure hot air direct from burning coal on a practical working scale. This we recently saw in operation at Chingford. It will be unnecessary to describe the various processes, involving complex and costly mechanical arrangements, by means of which Mr. Gibbs arrived at the final results. Suffice it to say that step by step he cleared away each difficulty, now chemical, now mechanical, until at length he has placed within the reach of the planter a simple and inexpensive mode of obtaining from coal or wood, or both, an air so pure that it can be inhaled without injury or inconvenience, and is therefore suitable for application to the most delicately flavored tea or other produce without the possibility of a taint.

The arrangement for effecting this result is extremely simple. It consists of a brick chamber, about 5 feet long by 2 feet wide and 2 feet high, built upon the ground. At one end is a feed chamber and a fuel chamber, and at the other a powerful exhaust and blast fan. Placed intermediately between the chamber and the fan are baffle plates, splitting plates, a standing bridge with perforations at the back, and a hanging bridge with perforations at the front. There are also several carefully proportioned inlets to supply the exact quantity of air requisite for perfect combustion. This exact apportionment of the air constitutes one of the main points of success, and it is the one which Mr. Gibbs found the most difficult to determine. Once known, however, this law of proportion between air and fire is, of course, easily maintained. Another point having a very important bearing on the result is the exact relative proportion of the fuel chamber to the feed chamber and of both to the volume of air drawn per minute by the fan. This also being ascertained, after many failures, is now a fixed instead of a doubtful quantity. Given these proportions and some others of minor importance, the result is distinctly curious. Issuing from a fan mouth 12 inches in diameter comes rushing a column of hot air, marking on the pyrometer at its exit a steady, uniform temperature of 500° Fahr. Not a trace of smoke or fume is visible to the eye; not a taint of any kind is perceptible to the taste or smell. Standing, as we did, in the range of the simoom, with the hot blast full in the face, the heat is, of course, excessive, but the stream of air is perfectly pure. Save in the matter of temperature, it affects neither the eyes, the throat, nor the nostrils. As a proof of this purity some choice tea which had been saturated with hot water was placed in the hot air current, and, when redried, was pronounced by an expert to be wholly free from any imparted taint or taste.

In order to show the character of the products of combustion before being submitted to the fiery ordeal, the fan was stopped, and a dense cloud of thick smoke rose up from the coal in the feed chamber, charged with suffocating fumes. On restarting the fan, it was quietly drawn in again, but not a sign of it appeared at the exit from the fan, and the air, when inhaled, was as pure as ever. It would be interesting to know the *rationale* of the process by means of which all the varied products from coal combustion are thus so completely destroyed. Mr. Gibbs suggests that the water contained in the coal is decomposed into oxygen and hydrogen, and that the hydrogen in burning adds to the heat of the resultant air, while the oxygen, re-enforced as it is by that obtained from the large volume of fresh air admitted at the various inlets, decomposes and purifies all these products. But, whatever the theory may be, the fact remains that it is not only possible, but easy and economical, to obtain the utmost amount of heat from coal without any deterioration of the atmosphere. The success attained by Mr. Gibbs naturally suggests the application of the principle in many important directions in connection with the industrial arts, as well as for steam raising purposes and for domestic use, by the supersession of open fires in stoves.—*London Times.*

Nothing could be more absurd than the statements above, that pure air may be obtained from the combustion of coal. Among the products of such combustion is carbonic acid gas, which is a deadly poison, and is formed in large volumes whenever coal is burned.

PRACTICAL METHOD OF TRANSFERRING AND COLORING PHOTOGRAPHS ON GLASS.

MR. W. M. ASHMAN, in the *Photographic News*, gives the following interesting details about the art of transferring and coloring photographs on glass, which has within a recent period been introduced under various names, as the ivorytype, the Romantype, etc.

The mounted photograph is removed from the card by immersing in water until the paste sufficiently softens to permit the print to be carefully removed without injury. Remove all paste from the back of the unmounted print, and trim a little smaller than the size of the glass to be used; rub the albumen side gently with a piece of linen rag dipped in benzoline as supplied at the oilman's, plunge into warm water, and after two changes blot on a clean towel; place the albumen side upward on a hard flat surface (a piece of plate glass), and apply the mounting solution or paste all over it.

Mounting solution is composed of:

French gelatine	20 grains.
Water	1 ounce,

to which is added an alcoholic solution of salicylic acid five drops; this requires warming up a little before using.

For mounting paste, use French gelatine, 20 grains, dissolved in water, one ounce; to this add an equal volume of ordinary starch paste and a similar quantity of Kingsford's Oswego blancmange, and twenty drops of an alcoholic solution of salicylic acid as an antiseptic; heat the above ingredients over a water bath for a few minutes, stirring the whole time; when cold, it is ready for use. To a previously clean convex glass apply some of the same mountant as used on the print all over the inside surface, then lower the print, albumenized side down, gradually on to the inside of convex glass. It does not require any great amount of skill to do this without blisters or creases; but, if such should occur, it may be easily withdrawn and mounted afresh. Well squeegeeing, to remove excess of paste, is the next operation, after which it may be placed on end to dry spontaneously, which will take from six to twelve hours, according to the temperature. To make a squeegee, procure a strip of rubber composition about one-eighth of an inch in thickness, cut one edge to fit the bevel of large plates, place a strip of wood on either side, and screw all together, leaving about one inch out on the beveled side. No squeegee will be found necessary when small plates are used, any excess being more easily removed by the fingers.

When the photograph is quite dry, place it on a cushion, and rub the paper away with fine glass paper, working gently in a circular direction, the object being to get the photograph as thin as possible, and thereby more easily permeated in the next operation; but care must be taken not to grind off all the paper.

There are several substances suitable for rendering the prints transparent, but the writer has found as good as any a mixture of:

Canada balsam	5 ounces.
Solid paraffine	2 "
White wax	2 "

Melt at as low a temperature as possible, then place the picture therein, keeping the composition in a molten condition either in a slow oven or on a water bath. If a high temperature be maintained, the print will lose its whiteness, and, when painted, will appear somewhat bilious. At the end of an hour the picture should be examined, when, if it is quite transparent, it may be removed, and when cool enough the excess wiped off. If, on the contrary, opaque patches are still visible, it should be allowed to get cold, then rubbed down a little more with glass paper, and again put into the wax composition, allowing it to remain until the marks disappear. When cold, rub off all excess, and proceed with the painting.

The writer was shown some pictures treated as above, but the painting was performed with a shilling box of water colors, and though so little had been done, it was really surprising what a pretty effect it had. To overcome the difficulty of putting water color on such a repellent surface, a friend said he had used shellac dissolved in borax as a medium to mix the colors; he then found no difficulty in working in any way he pleased on the print, while for the back glass, water answers equally as well as on colors; but this class of picture seems to lend itself particularly to oil colors.

Having prepared the photograph, the next thing will be to describe, as concisely as possible, the operation of coloring. The glass supporting the photograph should be laid on the retouching desk, concave side upward, and the most important points noted. These comprise such things as the eyes, lips, high lights, hair, flowers, jewelry, and small details, etc., for they must be all colored on the back of the photograph. It is recommended that the beginner paint in the hair, flowers, and jewelry, before attempting the eyes, for they will be found more difficult than any other part of the process. Mix a little each of Naples yellow, Indian yellow, and poppy oil for very light golden hair; burnt sienna and poppy oil for brown hair; and black, Vandyke brown, and poppy oil for very dark hair. Linseed and boiled oil may be used for the purpose instead of poppy oil; but the latter will be found to answer every purpose.

Having applied the paint to the hair, turn the glass round to see the effect; also whether the whole surface has been covered or not. Should it have been satisfactorily performed, the lips and cheeks may be done next. They should be painted with a mixture of vermilion and carmine in the following manner: Run a line of color along the surface with a brush well charged with color, softening it off with a dry brush; while working with this color, put a spot in each nostril, to warm up the heavy shadows in the photograph—also in the corner of the eyes, and any other part of the picture requiring that mixture. It will be well to again examine the picture from the front.

All being satisfactory, the eyes may be next attempted. Paint the pupil with pure black, and the light spot in the iris with Chinese white. Mix a little blue with the Chinese white for the white of the eye. When

quite dry, paint the iris with a mixture of ultramarine and poppy oil for deep blue eyes; mix black, white, and ultramarine for gray eyes; and for dark brown eyes use Vandyke brown with black, using poppy oil in each case. If the colors are not strong enough, they may be strengthened; but the first must be allowed to get quite dry before the second application, otherwise a muddy effect will be produced.

Eyebrows, mustaches, and whiskers are colored by laying on the color sparingly, and softening off with a dry brush. There should be just enough color laid on to do this nicely, because too much will look harsh, and not enough tends to flatten the picture.

Paint the jewelry in solid color, using, for gold, Indian yellow, Naples yellow, and vermilion; for silver, use Chinese white and black.

Lace should be touched up, the lights with Chinese white laid on thickly, and the shadows with gray composed of black and white. When the colors are dry, attach the second glass by means of gummed paper. Mix Chinese white with all the colors to render them opaque, and apply them roughly over the surface, no part of which should be left uncovered. The flesh color is composed of Naples yellow, vermilion, carmine, and Chinese white, thickly laid over the flesh parts, deepening the cheeks if necessary with vermilion, the shadows with a slight admixture of ultramarine, according to the subject.

Dresses will, in many cases, be left to the taste of the operator; and in painting them it must be borne in mind the sort of background that is intended, for harmony must prevail where large surfaces—such as backgrounds and dresses—are treated. Otherwise, however nicely the flesh and other details may have been executed, if the larger surfaces do not agree, the result must be considered a failure (loud, in fact). Any work put on, if found afterward to be unsatisfactory, may be easily removed with rectified spirits of turpentine on a piece of linen rag, and the same substance will be found useful for cleaning the brushes, finishing them in a little methylated spirit.

The principal tubes of color required will be Chinese white, black, Vandyke brown, chrome No. 1, burnt sienna, Naples yellow, ultramarine, Indian yellow, carmine, vermilion, also a bottle of poppy oil; brushes and palette, turpentine, and methylated spirit.

SPECTRO-TELEGRAPHY.*

Spectro-telegraphy is the name of a new invention by Paul la Cour, the inventor of the phonic wheel, and its synchronism for multiplex telegraphy. The instruments are shown at work at the present moment in the Copenhagen Industrial Exhibition, and the invention, which is patented, is based upon quite a new principle. It may be used for several purposes, but I shall here confine myself to pointing out and describing in detail the application of the system to nautical use as a simple means of communication from lighthouse to ship, and *vice versa*, and between ships themselves.

It is well known that such a signal system exists, but it is only available in the daytime. The first idea was originated in England, in 1857, it was taken up by France, and afterward by nearly all maritime nations, and is known as the international flag system. Generally speaking, the signals are not meant to express words and sentences by spelling, but only to give a limited though very large number of sentences, which are arranged in a signal book (international code of signals). It has the advantage, however, that each vessel can carry a signal book in its own language, and two ships of different nationalities are thus enabled to correspond without understanding each other's language.

The signaling is accomplished by means of 18 flags and pennants, each of which indicates one of the letters, B, C, D, F, G, H, J, K, L, M, N, P, Q, R, S, T, V, W. Of these are then formed two, three, or four flag signals, respectively, in the number of 306, 4,896, and 73,440. All the two and three flag signals and the 2/18,960 first 1/— of the four flags are intended for the different communications, queries, and answers. The others are reserved as "distinguishing signals" for ships, 1,440 for man-of-war and 53,040 for trading vessels.

Fig. 1.

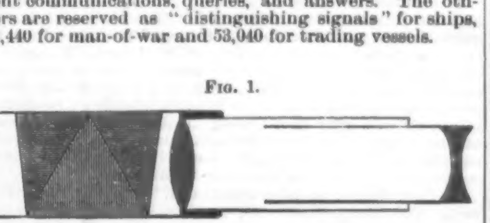


Fig. 2.

Fig. 3.

The large extension which this system has attained in a comparatively short period is a proof of its practical arrangement; still it has one disadvantage, namely, it is useless at night, and yet ships sail as much then as in the day. The value of this mode of correspondence is thus reduced one-half, and an owner wishing to give final instructions to his captain by this means hesitates in doing so, as he is not certain that his ship may pass the lighthouse in the day.

La Cour's system is not intended to supersede the present flag system, but to supplement it in the night. This invention enables us to utilize a corresponding *modus operandi* at night by means of the same signal book, and in such a way that the night duty becomes as simple as the day duty, and even possesses certain advantages over the latter.

When we observe a distant white light, a star, or the light from a lighthouse through a prism with vertical edge, then such a light, as is well known, appears as a horizontal luminous line, consisting of red, orange, yellow, green, blue, indigo, and violet colored rays. Sir Isaac Newton discovered that this was owing to the fact that the white light in reality is a combination of all these colors, with their infinitely many shades, and that they are refracted differently in the prism and thus separated, while they can again be combined and reproduce the white light.

Instead of a simple, a compound prism may be used. The latter separates the color rays, but does not, on the whole, deflect them much from their original direction, and such a prism fixed on a telescope (Fig. 1) is specially adapted to dissolve the in-going light. When a distant *white* spot of light is observed through this, a luminous line (Fig. 2) is seen in the field of the telescope, *colored from red to violet*.

If now the person *who is sending* the light signal is capable of providing, in a simple manner, that all the color rays are not emitted, but only some, while others are entirely removed, it can be arranged so that the

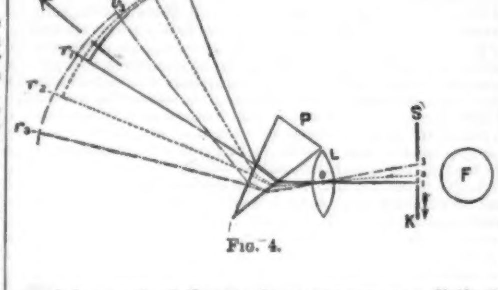


Fig. 4.

remaining part of the spectrum appears as a distinct signal, for instance the Morse signal - - —— (Fig. 3). This is exceedingly easy to decipher, and does not even require color sense, for although it is differently colored, yet it is only the shape which is of importance (the colors are only the means of providing the conventional shape), and the signal can be made by any one, even the color blind.

The sending instrument is represented diagramatically in Fig. 4, which shows a horizontal section of the instrument (it is about 1 foot high and long and 8 inches wide), together with the rays of light on their road to the horizon. F is the lamp, S, K is the screen, in which openings are cut corresponding to the signals to be sent, for instance, two small openings (1 and 2) and one wide (3), corresponding to the signal - - ——. L is a lens, the distance of which from S, K is equal to its focal length. Therefore all the rays of light which through the opening, 1, strike the lens, L, will after passing through it, become parallel with the line, 1—0, from the opening, 1, to the optical center of the lens (0). The other rays of light are therefore not shown, for they have the same direction as 1—0. This ray of light will then strike the prism, P, and be refracted and spread, so that it forms the colored, fan-shaped rays of light, r_1, v_1, containing all the colors. In the direction of the distant observer, *i*, a distinct color only will be emitted from the opening, 1, say *orange*; from the opening, 2, there will also be rays emitted, which are first made parallel by the lens, and afterward spread by the prism in the fan shape r_2, v_2, of which a single color only strikes *i*, say *yellow*. In the same way the opening, 3, produces the fan shape r_3, v_3, but this opening being wider, *i* will receive several kinds of *green* and *blue* rays.

To the naked eye, or with an ordinary telescope, the light which issues in the direction *i* will give shades of color corresponding to a mixture of the respective colors; but if the spectro-telegraphic telescope is used, the signal appears as in Fig. 3.

When the sender moves the screen, S, K, in the direction indicated by the arrow, opening 3 will take opening 2's place, opening 2 take 1's place, and in the field of the telescope the receiver will also see the line of light, 3, slide smoothly into 2's place, etc., etc., so that the signals are seen to glide through the field, in at one side and out at the other.

To perfect the present system of signaling, and use La Cour's signals at night, a sending instrument, with the 18 perforated metal pieces, together with the receiving telescope, is only required. Instead of hoisting the four flags in the daytime, signifying, for instance, C, F, G, L, the four corresponding pieces of metal need only be inserted in the sending lantern, and made to move backward and forward several times, so that the receiver has time to read them.

These night signals are in some respects superior to the day signals. They are, for example, not diminished by distance, as their size only depends upon the receiving telescope, so that, however far they are sent, they keep the same dimensions. They are also independent of the direction of the wind, which often disturbs the flag signals by making them turn edgeways to the observer, so that he cannot see them.

This same system has been tried for ordinary telegraphy, by passing a perforated slip (as in the Wheatstone's transmitter) through the sending instrument, and a telegraphist can read these marks so easily that the telegraphing can be performed with the same speed as with an ordinary Morse instrument.

It is well known that a hazy atmosphere first obliterates the violet and blue rays of light; it has therefore been supposed by some that spectro-telegraphy would fail under these circumstances. This is, however, not so, for as the signals seem to glide through the whole spectrum, they can always be read in the red, yellow, and green, even if they are lost in the violet and blue.

This principle also appears to be applicable in several different ways. If a lighthouse is supplied with a sending instrument, in which the first letter or letters of the light's name are placed, the mariner will always be able to see in the spectro-telegraphic telescope what light it is, and thus mistakes and loss may often be prevented.

Further, an entrance to a harbor does not need to be indicated by *two* lights, which direct the course, but by *one* only of La Cour's system, with a fixed signal or letter, which is only seen in the middle of one's telescope, if one is exactly on the right track. By steering a little to the one side or the other, the letter or signal will appear to glide in the telescope to either of the two sides, and if the ship passes entirely out of the proper course, the signal disappears from the field of the telescope. Another advantage in this method is, that the light from the harbor lantern is very easily distinguished from all other lights, for these latter appear in the telescope as a continuous light from red to violet, whereas the former gives its own peculiar signal, for example, - —— - ——.

Finally, ships might be supplied with a fixed lantern of this kind, which throws light forward, and obliquely to the sides. Two ships going in opposite directions will thus in their telescopes immediately see whether their course lies to the starboard or port of each other, and also whether they are in the act of altering their helms, for the letters in the telescope will then appear to glide to one side or the other.

* Translated from the Danish. Communicated by Mr. P. Chr. Dresing.—*Electrical Review.*

THE VOLTAIC BALANCE.

By Dr. G. Gore, F.R.S.

A New and Simple Lecture Experiment.—Take two small clean glass cups containing distilled water; simultaneously immerse in each a small voltaic couple, composed of either unamalgamated magnesium or zinc with platinum, taking care that the two pieces of each metal are not from the same piece and are perfectly clean and alike. Oppose the currents of the two couples to each other through a sufficiently sensitive galvanometer, so that they balance each other and the needle does not move. Now dip the end of a slender glass rod into a very weak aqueous solution of chlorine, bromine, iodine, or hydrochloric acid, and then into the water of one of the cups. The voltaic balance is at once upset, as indicated by the movement of the needle, and may be shown to a large audience by means of the usual contrivances.

The direct circumstance to be noticed is the extremely great degree of sensitiveness of the arrangement in certain cases; this is shown by the following instances of the minimum proportions of substance required to upset the balance with an ordinary astatic galvanometer of 100 ohms resistance, and with a Thomson's reflecting one of 3,040 ohms resistance.

1. *Zinc and Platinum with Iodine.*—With the astatic galvanometer, between one part of iodine in 3,100,000 and 3,521,970 parts of water.

2. *Zinc and Platinum with Hydrochloric Acid.*—With the astatic galvanometer, between one in 9,300,000 and 9,388,185 parts, and with the reflecting one, between one in 15,500,000 and 23,250,000.

3. *Magnesium and Platinum with Bromine.*—With the astatic galvanometer, between one in 310,000,000 and 344,444,444 parts.

4. *Zinc and Platinum with Chlorine.*—With the astatic galvanometer, between one in 1,264,000,000 and 1,300,000,000 parts.

5. *Magnesium and Platinum with Chlorine.*—With the astatic galvanometer, between one in 17,000,000,000 and 17,612,000,000 parts, and with the reflecting one, between one in 27,062,000,000 and 32,291,000,000 parts of water.

Every different soluble substance requires a different proportion, and with unlike substances the difference of proportion is extremely great. With solutions of neutral salts, the proportion of substance required to upset the balance is large; for instance, with chlorate of potash, a zinc platinum couple, and the astatic galvanometer, it lay between 1 part in 221 and 258 parts of water.

The degree of sensitiveness of the balance is usually greater, the greater the degree of chemical affinity the dissolved substance has for the positive metal and the less it has for the negative one.

By first bringing the balance with a magnesium platinum couple and the astatic galvanometer nearly to the upsetting point, by adding 1 part of chlorine to 17,612 million parts of water, and then increasing the proportion to 1 in 17,000 millions, the influence of the difference, or of 1 part in 500,000 millions, was distinctly detected.

OSMIUM.

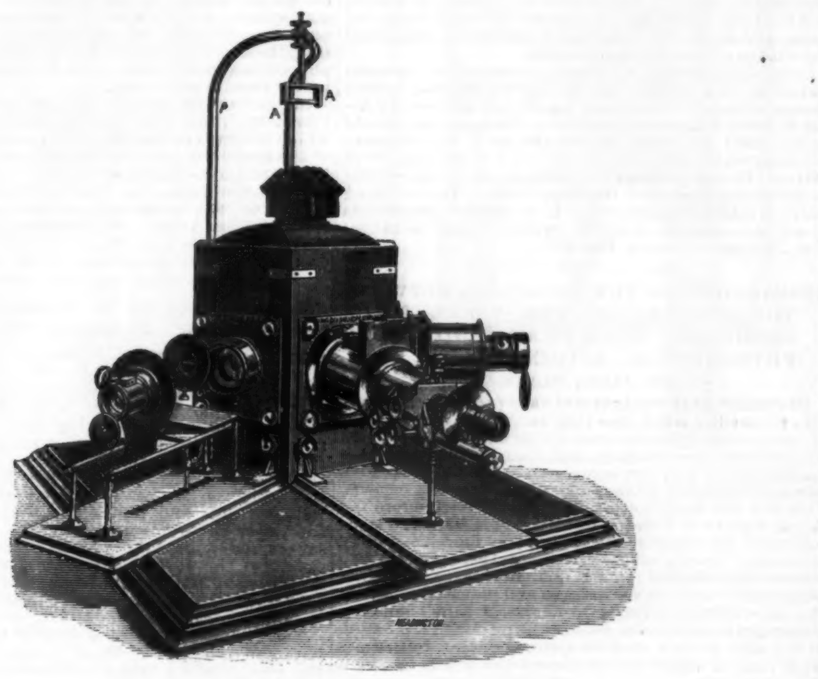
The atomic weight of the element osmium has been redetermined by Prof. Seubert. The necessity for this redetermination has been felt ever since the principle of periodicity began to take firm root in the minds of chemists; and the more recent values arrived at for the atomic weights of iridium, platinum, and gold have tended to render this necessity even more imperative. The natural sequence, according to their chemical and physical properties, of the metals of the platinum group is generally accepted as—osmium, iridium, platinum, gold. Now, the atomic weight of iridium as determined in 1878 by Seubert is 192·5, that of platinum as fixed by the same chemist in 1881 is 194·3, and that of gold as estimated last year by Thorpe and Laurie, and by Kruss, is 196·7, while the recognized atomic weight of osmium as given by Berzelius in 1828 is so high as 198·6. Obviously, if the grand conception of Newlands, Mendelejeff, and Lothar Meyer is correct, the atomic value of osmium required most careful revision. Such an undertaking, however, is endowed with peculiar interest owing to the dangerous nature of work with the osmium compounds, and many chemists who have been interested in this subject have been deterred by the knowledge that accidental contact with the fumes of the tetroxide, which are so frequently evolved by the spontaneous decomposition of many osmium compounds, might deprive them of the use of their eyes forever. Prof. Seubert has happily succeeded without accident in establishing the validity of our "natural classification" by means of the analysis of the pure double chlorides of osmium with ammonium and potassium, $(NH_4)_2OsCl_6$ and K_2OsCl_6. Both these salts were obtained in well-formed octahedral crystals, of deep red color while immersed in their solutions, but appearing deep black with a bluish reflection when dry, and yielding bright red powders on pulverization. The method of analysis consisted in reducing the double chlorides in a current of hydrogen; in case of the ammonium salt, the spongy osmium which remained after reduction was weighed, and the expelled

ammonium chloride and hydrochloric acid caught in absorption apparatus, and the total chlorine estimated by precipitation with silver nitrate. In case of the potassium salt, the expelled hydrochloric acid was absorbed and determined, and the metallic osmium left after removal of the potassium chloride by washing was weighed. The mean value yielded by all these various estimations is 191·1, thus placing osmium in its proper place before iridium, and removing the last striking exception to the "law of periodicity."

HUGHES' LECTURE LANTERN.

At a recent meeting of the Physical Society Mr. W. Lant Carpenter exhibited a new lantern for lecture purposes, which we illustrate below. The lantern was devised by Mr. W. C. Hughes, of Kingsland Road, London, with the special object of facilitating the change of image thrown on the screen. Thus a lecturer can by means of this combination lantern rapidly bring before his audience first the general view of an object, next some detail, and thirdly an enlarged microscopic view of any part, simply by turning the lantern on its vertical axis; or different stages in a chemical or physical experiment can be shown in quick succession. The body of the lantern is a hexagonal prism, and each of the three adjacent front sides is fitted with projecting apparatus, the other three sides being provided with openings to give access to the interior. On the recommendation of Mr. Lant Carpenter, the Brockie-Pell focusing arc lamp has been chosen as the illuminant; but the ventilating arrangement and general construction admit also of the use of the oxy-hydrogen light, if electric energy be not available.

The first slide, that shown on the left in the illustration, is fitted with a "Gilchrist" demonstrating lantern, the prism and projecting lenses being movable along a pair of rails. The next, or middle slide, is fitted as a lantern microscope, with alum cell, mechanical stage for horizontal and vertical adjustment, and provided with various sets of lenses and objectives, while the third slide is arranged for spectroscopic work. To bring the beams of either one or the other of these slides on to the screen, all that the lecturer has to do is to turn the body of the lantern in the required direction, a spring catch fixing it in the exact position. To facilitate the turning, the lantern is mounted upon metal rollers.—*Industries.*



HUGHES' LECTURE LANTERN.

THE BITTER WATERS OF HUNGARY.

Patriotic Hungarians are grateful to nature for having made the capital of their country the source and center of many and varied mineral springs. No city is more favored than Buda-Pesth in this respect. In other countries than Hungary the inhabitants of the capitals have to leave them, and they must often make long journeys if they wish to drink and bathe in mineral water at the fountain head. The inhabitants of Buda-Pesth have many and some unique healing springs almost at their doors, while strangers travel far to profit by the benefits which they can enjoy without leaving home. The capital of Hungary is one of the best frequented watering places in the world.

The springs in and near to Buda-Pesth consist of three classes. First, there are sulphurous springs; secondly, there are ferruginous waters; and thirdly, there are the bitter waters, which cannot be found in greater strength, purity, and abundance elsewhere. Though my intention is to give a detailed account of these bitter waters and of the place where they abound, I may preface it with some particulars about the other springs, which are less known out of Hungary than they deserve to be.

For those readers who have not visited Buda-Pesth it may be useful to state that the city is divided into two parts by the Danube, and united by three bridges. Pesth is on the left bank of the river, and, though the handsomer and more imposing of the two parts, has no mineral spring of importance. Between the two and above the bridge, higher up the river, is Margaret Island, where mineral water issues from the earth at the rate of 180,000 cubic feet in the twenty-four hours. On the right bank is Buda, or Ofen as it is called in German, and here the most important, as well as some of the oldest, springs are to be found. Margaret Island is about a mile in length by about a quarter of a mile in breadth. In olden days it was a royal hunting ground, and was known as Hare Island. At the middle of the thirteenth century King Bela IV. built a church and a convent on the island; the ruins of both still remain. Margaret, the king's daughter, entered the convent, and died there in the odor of sanctity in 1271. The island was named after her. As is well known, the virtues of good Catholics, like those of good wine, mature with age; besides, they become magnified by tradition, and thus it was, perhaps, that nearly three centuries after Margaret's death she was elevated to the dignity of a saint.

The hot mineral water which is now the chief attraction on Margaret Island is a discovery of comparatively recent date, and was the result of sinking an artesian well. The water is sulphurous in character, and is used both internally and externally. Though smelling strongly of sulphur, it has not an unpleasant taste. The bath house is a large and handsome building, and the Hungarians think that there are few finer establishments of the kind. It contains upward of one hundred separate baths in stone, marble, porcelain, and metal. The floors of the bath rooms are formed of red marble. Besides the mineral water baths, electric and other baths are contained under the same roof. Indeed, it is not without justice that this bath house is pronounced one of the finest and most comfortably arranged to be found anywhere. The grounds in front of it are beautifully laid out and kept in perfect order. Archduke Joseph, who has been the proprietor of Margaret Island for several years, deserves credit for what he has done there, all the improvements being due to him. Besides beautifying it and providing luxurious bathing accommodation, he has built two hotels for the reception of visitors who prefer living on the spot to journeying backward and forward by boat from the city. At the end nearest the city, and adjoining the first landing stage for the steamers plying between it and the island, there is a large restaurant and concert room. Here people come to hear the music, to dance and enjoy themselves, so that the island is a place of daily resort for amusement, as well as one to which invalids go for relief.

Another island, smaller than this one, and connected with it and the left bank of the river by two iron bridges, also contains a mineral water bath house, to which the mineral water is conveyed through pipes from an artesian well. It is called Palatine Island; the artesian well is in the Stadtwäldchen. This well took upward of nine years to sink, and is reputed to be the deepest artesian well in the world. The mineral water issues from it at a temperature approaching boiling point, a cloud of steam showing the place where the water rises. Far more noteworthy for the historical student is the fact that near the spot where this well has been bored is the meadow wherein from the tenth to the fourteenth century the Hungarian Parliament met and deliberated under the canopy of heaven. There is no record of any member complaining of the ventilation being bad and the sittings being too protracted.

In Buda or Ofen the baths and springs have many historical associations. They have been known and used for eighteen centuries. Remains from the time that the Romans occupied this place indicate considerable physical changes in the ground. Nevertheless, some of the baths used by them are in use now, and the sulphurous water which they considered curative retains the same reputation. Chief among these baths is the Kaiserbad. After the Roman occupation was over, this bath was beautified by the Hungarian king, Matthias Corvinus. When the Turks were masters of Buda, this bath was enlarged by Mahomet Pasha. Not far distant from the Kaiserbad is to be seen, in the midst of a vineyard, the tomb of a Turkish holy man, which is still an object of pilgrimage for pious Mahometans out of the remote East. Centuries have elapsed since the tomb was erected. Its preservation is owing to a special provision in the treaty of peace made in 1699, after the rule of the Turks in Buda was ended by the victories of the Christians. The Romans, the Tartars, and the Turks have waged war in turn at Buda-Pesth. Both the Romans and the Turks have left behind them some not unpleasant memories, and many tokens that they were civilized and versed in the arts of peace and the pleasures of life. The Tartars, on the contrary, have left nothing to mark their passage and power save traditions of their savage cruelties and of their ferocity as destroyers.

The Kaiserbad contains not only mineral water, but also Roman and vapor baths, and a large swimming bath. Everything is designed for comfort, and pleasure is combined with it. A band plays several times daily during the season, which lasts from the middle of May till the middle of September. During the winter the chief frequenters of it are the citizens of Buda-Pesth, and the vapor bath is then chiefly used. The purposes for which persons resort to the baths I have named, and others of less importance which I need not describe, are to obtain relief from chronic gout and rheumatism, catarrh of the chest and stomach, constipation, and intermittent fever. I should add that there are some iron springs in Pesth which are used for bathing, but they are not specially remarkable. Wherever one travels in the Austro-Hungarian empire one finds Giesshübler water, which comes from a place of that name in Bohemia, the favorite drink at table, where it is taken plain or mixed with wine. Many other table waters are in rivalry with it, and the citizens of Buda-Pesth lay much store upon one which was discovered in 1879 at Moha, and which is called St. Agnes water. Being assured that it was quite as good as Giesshübler I tried it, but I was not convinced. St. Agnes water is a pleasant beverage, but Giesshübler is pleasanter still, and, I should think, much more wholesome.

Having briefly described the principal mineral baths and springs in the Hungarian capital, I shall proceed to describe the bitter waters, which possess even more general interest and which are a short distance from it. Half an hour's drive on the right bank of the Danube brings one to the spot where these waters are found. They are in a wide plain, and on the slopes of the hills which rise on one side are vineyards, where the grapes grow from which the wine Ofen Adelsberg is made, a wine which is classed among the best produced in Hungary. Unlike several mineral springs nearer the city, the bitter waters were not discovered till the year 1853. The famous Sprudel at Carlsbad is said to have been accidentally made known by a dog; the spring at Teplitz is said, probably with as great truth, to have been found by an intelligent pig; at Homburg the fondness of horses and cattle for the water in the marsh where the Elizabeth, Louisa, Ludwig, and other springs now attract drinkers first made known the fact that the water had peculiar virtues. Indeed, some fable or strange tale is associated with the discovery of most mineral springs. No miracle was wrought when the existence of the bitter waters was made known. The story is both simple and true. About the year 1853 an inhabitant of Buda or Ofen was the proprietor of the ground upon which the Queen Elizabeth Salzbad now stands. He was named George Schleiss, and he was a market gardener. The only water accessible was at some distance from his garden, and he required much of it in the hot weather to water his vegetables. Unless the ground be plentifully watered during the hot months, no plants will thrive in this locality. Accordingly, he dug a well to the depth of thirty feet and found water in abundance. As it had a salt taste he did not use it for drinking purposes, but applied it solely to irrigate the ground. One day a gentleman who had been out hunting was returning home, and being thirsty he drank of the water, which he at once pronounced to be highly mineralized, and he advised the proprietor of the well to have this tested by analysis. George Schleiss took some to a chemist named Francis Unger, who was so much impressed with its medicinal properties that he entered into partnership with him, and from the year 1853 the bitter water became an article of consumption and commerce.

Before the fame of this water was noised throughout the land, the inhabitants of Buda-Pesth became frequent drinkers of it; they bathed in it also, and many derived much benefit. In consequence of this a bath house and pump room had to be erected, and a few rooms were provided for those who desired to pursue the treatment on the spot. Medical men all over the Continent soon learned the medicinal value of this water and prescribed it to their patients; thus a demand sprang up for it, and searches were made for other places where it might be obtained. Several other wells yielded bitter water; but many wells were sunk in vain, and much money was wasted in attempts to find it where nature had not been generous. As in the case of the petroleum wells in the State of Pennsylvania and the Province of Ontario, so was it in this one. For one petroleum spring which yielded a fortune, two absorbed capital. Now, however, the limits of the bitter water yielding ground have been determined, so that no one thinks of wasting time and losing money by seeking for it outside a particular area.

At present about forty wells yield bitter water, and seven persons or companies are their proprietors, and superintend the bottling and sending of it to market. The one first discovered is nearest the city; the one best known in England is the furthest from it. This belongs to Herr Andreas Saxlehner, and bears the name of Hunyadi János. If not actually introduced into England by the company which supplies Apollinaris water, this bitter water has been chiefly pushed by that company, which contracted to take a certain number of bottles yearly. Before noticing the wells separately, I may remark that the water from one resembles generally that from another. The differences are in the respective quantities rather than in the nature of the ingredients. In certain cases the bottling is conducted with greater care than in others, and this causes the water to keep longer and in better condition. Some of the wells are decidedly weaker than others. The possessors of the weaker waters cannot help themselves; but those who have several wells can combine the waters of each, and thus produce a good average strength. This is done, I believe, by Herr Saxlehner, who bottles more water than any competitor, and who has several wells on his property. It is with this bitter water as with Vöslau, the celebrated Austrian wine. The demand for one brand of that wine, called Vöslauer Goldeck, is larger than for any other; yet though the wine of one year may vary in quality, there is never any appreciable difference between one bottle of Vöslauer and another. This is understood to be arrived at through what is styled "blending." Hungarian bitter water can be, and sometimes is, "blended" also.

Next to the Hunyadi János comes the Rákóczy well, the water from which is stated to be so strong that it bears mixing largely with plain water or milk without detriment to its aperient qualities. The proprietors of this well produce a salt by evaporation which has many of the properties of Carlsbad salt. The proprietors of the Victoria well say that the water from it is stronger still. I may remark, in passing, that over the area where the bitter water is found, and in close proximity to a well containing it, a well sunk to the same depth will yield potable water which is free from all trace of mineral substances. The explanation doubtless is that all the water at a certain depth is uniform in character and is non-mineralized, but that the water in particular spots derives its mineral constituents from the strata in which it lies, or through which it passes. Three other wells may be named. They are—first, Franz Josef; secondly, Hunyadi László; and thirdly, Æsculap. The second belongs to a French, and the third to an English company.

The principal constituents of all these bitter waters are the sulphates of magnesia, soda, and lime, chloride of sodium, and bicarbonate of soda. The percentage of carbonic acid gas is small. It is owing to the large proportion of sulphate of magnesia contained in them that they are called bitter waters, sulphate of magnesia being called "bitter salt" in German. At one time English children, as well as grown-up persons, were painfully acquainted with this salt under the name of "Epsom." But the sulphate of soda and other ingredients cause the Hungarian bitter water to be a pleasanter aperient than Epsom salts and quite as effective. Abernethy had a great dislike to the employment of Epsom salts. He used to compare the effects of taking a dose to the irruption of wild and sanguinary Arabs into a peaceful village. On the other hand, the operation of Hungarian bitter water may be likened to the action of a policeman, directing and compelling obstructionists to move on. Had Sydney Smith been alive he would have welcomed this bitter water as a blessing to men. He delighted in mild yet potent remedies. In one of his humorous passages he ridiculed an assumed attempt to cripple the French army by prohibiting the export of rhubarb. Certainly the French are fond of and, it may be presumed, are good judges of aperient medicines, and it is natural, then, that the sale of Hungarian bitter water in France should be very large. All over the Continent the annual consumption is enormous, being relatively far greater than in England, where the water is not yet so well known. I am informed that the demand increases in foreign countries at a rapid rate, and that many million bottles are dispatched annually. I have before me a large number of testimonials from medical men in favor of this water. It seems to cure or benefit as many forms of disease as any quack medicine. I note that it has been used with remarkable results in the Imperial and Royal Hospital for Lunatics at Vienna. I fancy that none of it has yet been drunk by the Bulgarians.

I should not advise any visitor to Buda-Pesth to proceed to the place which yields bitter waters if there were nothing more to be seen than water pumped from wells and poured into bottles. Even this monotonous spectacle cannot be enjoyed at every establishment I have named, as the proprietors of some wells seem to fear lest strangers should discover hidden secrets if admitted within their premises. They certainly need not dread any one betraying an unquenchable thirst for the water itself and trying to drink a well dry. A very little bitter water goes a very long way. In this case moderation is a necessity rather than a virtue. Nor is the scenery particularly beautiful. What I found to interest me, and what might interest others also, was the fine bathing establishment belonging to Messrs. Mattoni & Wille, and called the Elizabeth Salzbad. It was here, as I have already said, that bitter water was first discovered. Here, too, persons requiring treatment went from Buda-Pesth to bathe in the water and drink it. Till the year 1881 all the arrangements were rude and primitive; now everything is done that the most fastidious visitor can desire. The baths are excellently arranged, and there is good accommodation for residents during the season, which begins on May 1 and closes on October 1. During the season omnibuses ply every half hour from five in the morning till eight at night between the Elizabeth Salzbad and Franz-Josefs-Platz in Buda-Pesth.

During the summer months many hundreds of persons sojourn at the Elizabeth Salzbad for the purpose of regular treatment under the care of the physician attached to it. Ladies are in the majority. It seems that this water is quite as efficacious in many female maladies as that of Franzensbad. Year after year the number of patients increases, and the supply of rooms is not equal to the demand. On this property, which covers eleven acres, there are ten wells. It has been ascertained that bitter water abounds all over it, so that more wells could be sunk if required. The original spring is used for drinking. It is the mildest of all the springs, and on that account can be employed with the greater ease and advantage. The water is not one to be drunk from choice, but when taken on the spot it is less unpleasant than when drawn from a bottle. As the dose is half of a small tumbler, not much time need be wasted in taking it.

The medicinal action of the bitter water when employed for a bath is said to be marked and useful in cases of gout, rheumatism, diseases of the bowels, nervous diseases, and female complaints. I took a bath, and found that the skin was slightly irritated, and also that the whole body was strengthened; but I have felt the same effects from a hot salt water bath. However, as there is no salt water near Buda-Pesth, this bitter water may be an excellent substitute, even if it be nothing more. A band plays every day near the pump room. There is also a reading room and library for the use of visitors, and a restaurant where one can dine as well as in the city. In one respect the dwellers at the Elizabeth Salzbad are better off than those who put up at a Buda-Pesth hotel, for they are not worried with too much music. At the hotels and restaurants in the city music is provided every way in over-abundance. The national dance of the Hungarians is called Czardas, and resembles a Scotch reel in many things, and among them in its interminable length. Now, when a Hungarian band begins to play it never seems to know, any more than the dancers, when to stop. If a musician be tired he rests, but the others continue to produce a variety of sounds having much resemblance to the weird and wearying strains of bagpipes. Hungarian music, like Hungarian bitter water, is pleasantest in moderate doses.

Visitors to the Queen Elizabeth Salzbad have the opportunity of seeing the whole process of preparing the water for export. They may drink as freely of it as they please, a privilege which, I understand, they never abuse. There are no secrets, nor is there any affectation of mystery in this establishment. Every question I put was readily answered. I learnt that this bitter water is less known in England than others which are extensively advertised; still there is some demand for it, owing to the *Lancet* and *Medical Times and Gazette* having praised it highly. It bears two names, one being "Royal Hungarian Bitter Water," the other "Hunyadi Matthias." In Germany and Austria, where it is known as "Ofner Königsbitterwasser," the sale is large, and a considerable quantity is sent to Italy and America. In France, however, the sale is largest, owing to the Academy of Medicine having pronounced it very good and to the leading French medical men prescribing it. It is one of the few foreign mineral waters which patriotic Frenchmen drink with satisfaction, and they drink it under the name of "Eau Purgative Hongroise."

Whether the attractions of Buda-Pesth in the shape of mineral waters are sufficient to warrant an invalid making the journey in order to undergo treatment there cannot easily be determined. It is probable that in certain cases the labor would be repaid. The city itself is well worth a visit, and the hotels are quite as fine as those of Vienna. Hungarian wine is renowned, and Hungarian cooking is, to my mind, far better than that of Germany, and in some respects superior to that of France. As is well known, the Hungarians are as proud of their language as of their country, and they speak it in preference to German. But the larger proportion of them know German also and are quite ready to converse in it. In Prague and other parts of Bohemia, where the Czechs are striving to substitute their language for that of the country at large, great reluctance is shown to speak German even by those who understand it perfectly. The visitor to Hungary is glad to find that this foolish form of patriotism is not displayed there, and he will be at no loss if he have a colloquial knowledge of the German tongue.

Considering the superabundant supply of mineral waters in and around the Hungarian capital, it may appear strange that any one should fall ill there, or, being ill, should not rapidly recover. Perhaps there would be less need for using mineral water if the ordinary drinking water were wholesomer and if drainage were better. In many streets the odors are as overpowering as the music in some of the restaurants. The drinking water is taken from the river. It is infinitely preferable to sail upon than to drink the waters of the beautiful blue Danube.—*London Times.*

RESEARCHES ON THE RELATIONS BETWEEN THE SPECTRA OF THE ELEMENTS OF INORGANIC SUBSTANCES AND THEIR PHYSIOLOGICAL ACTION.

By JAMES BLAKE.

In pursuing his researches always in the same direction the author has found that the action of a number of inorganic substances upon living matter depends on their isomorphic relations, and that all substances belonging to one and the same isomorphous group give rise approximately to the same physiological reactions. This fact was made known in a memoir read before the Royal Society of London in 1841, and it has been since confirmed by experiments made upon more than forty elements. Among all these elements there are only two whose physiological action does not agree with their isomorphic conditions—nitrogen and potassium. When the same element forms two classes of salts belonging to distinct isomorphous groups, the physiological action of the salts of each class is quite different, but agrees with that of other substances of the group to which it belongs.

Another fact observed by the author connects the physiological action of these substances to their molecular constitution—*i. e.*, in one and the same isomorphous group the pysiological action augments in intensity with the atomic weights of the elements present. The higher the atomic weight of an element, the less of the substance is required to produce the same physiological reaction. This is a fact which demonstrates very distinctly the difference between these physiological reactions and ordinary chemical reactions. On considering the reactions of these substances from a physiological point of view, the author finds that it is by their action upon the nerve centers of organic life, more or less specialized for each isomorphous group, that these reactions are explained. Thus the compounds of the alkaline metals act upon the internal ganglia of the heart; the compounds of phosphorus, arsenic, and antimony act upon the splanchnic ganglia; the substances of the magnesian group act upon the center for vomiting; and in an analogous manner for other groups, it is by modifying the action of some nerve center that their physiological action is shown.

The spectroscope has opened out to us a path where physics and chemistry coalesce, where the molecular vibrations whose number we may count and whose length we may measure give rise to reactions of which we may grasp the results without having found the play of the forces by which they are determined.

Thanks to these discoveries which refer to the questions which engage us, the author considers that we are now in a position not merely to explain why chemistry could not render an account of the results of his former experiments, but also find the direction in which must be sought the law which connects the physiological action of these inorganic substances with their physico-chemical properties.

In 1867 Mitscherlich discovered that the elements of one and the same isomorphous group have spectra which resemble each other, or are homologous. Still there are two elements, nitrogen and potassium, which form an exception to this rule, and these are the same two elements which form an exception to the rule according to which the physiological action of the elements is connected with their isomorphous state. This fact has led the author to investigate if the action of these substances upon living matter is not connected to the molecular vibrations of which they are the seat, and which are revealed in their spectra. It is found that isomorphous substances give rise to the same physiological reactions when they have homologous spectra, but when in an isomorphous group there are found elements whose spectra do not resemble the spectra of other elements of the group, these elements with anomalous spectra give rise also to anomalous physiological reactions. When, as it has been said, an element gives rise to two classes of salts the physiological action of these two substances is very different, and there is found a difference quite as strong between the spectra of the substances in the two classes. The physiological action of the elements in the various isomorphous groups shows that for two of these groups their action bears only upon the peripheric ganglionary centers; these are the group of the alkaline metals and the group of phosphorus. As for the alkaline metals, the author has proved that after the injection of several grms. of sodium nitrate into its veins, an animal may live for a number of hours without any sign of a reaction given by a nerve center. The same fact reappears if we inject into the veins compounds of phosphorus, arsenic, and antimony. After the injection of three grammes arsenic acid into the veins we can observe no symptom which might indicate an action upon the cerebro-spinal nervous centers.

These two isomorphous groups have both very simple spectra. Of all the alkaline metals, sodium and thallium have the simplest spectra. Their salts may be present in the blood in the greatest quantities in respect to their atomic weight, without reacting upon a central nerve ganglion, while the salts of cæsium, with a more complicated spectrum, give rise to very slight symptoms when injected into the arteries. In the phosphorus group the same phenomenon is repeated. It is here again nitrogen, with a very complex spectrum, which, of all the known elements, reveals its presence by its action upon the nerve centers, and is distinguished in the sharpest manner from that of all the other elements of the same group. There are other facts which are better explained by referring them to the molecular vibrations of the reagents than by any other hypothesis. That the poisonous action increases with the atomic weight among substances having homologous spectra is a fact which is explained if we refer these physiological reactions to molecular vibrations. Further, the fact that these reactions rank among catalytic phenomena lends itself also to the same explanation better than to any other.

In the present state of our knowledge on the nerve vibrations, and also on the molecular vibrations, which hitherto lie hidden in the ultra-thermic region of the spectrum, the relation between molecular vibrations and physiological reactions remains, of necessity, a mere hypothesis; but the fine discoveries of M. Deslandres on the numerical relations subsisting among the molecular vibrations in spectra promise to endow science with a new means of approaching the problems of kinetic physiology.—*Comptes Rendus*, *Chem. News.*

MAGNETIC SEWAGE WORKS—THE ACTON MAIN DRAINAGE WORKS.

AT a recent meeting of the Society of Engineers, London, a paper was read on "The Acton Main Drainage Works," by C. Nicholson Lailey.

After glancing historically at the origin of the Acton drainage works, and showing that neither a sewage farm nor the lime process was admissible, the site of the works being near the Bedford Park estate, and close to an intended public recreation ground, a position which made the entire absence of foul odors, as well as a clear and pure effluent, absolutely essential, the paper gave an account of the formation of the sewers under disadvantageous circumstances, and the details of the works. These are situated on a triangular piece of ground about five acres in extent, and comprise precipitating tanks, the chemical buildings, and the pumping station.

The drainage of Acton is divided into two sections, a high and a low level. The high-level sewage flows into the precipitating tanks by gravitation, but the low-level requires pumping. Underneath the pumps is a storage tank for the low-level sewage, capable of holding 50,000 gallons. The precipitating tanks are three in number, and will hold 138,000 gallons of sewage each. In addition to these are two smaller tanks, one of which contains the magnetic spongy carbon filter bed, and in the other it is intended to construct another similar filter when increased population renders it necessary.

The "magnetic process" consists (1) in precipitation of the solids and (2) in filtration of the effluent through a bed containing a layer of "magnetic spongy carbon." This "magnetic carbon" is a hard material of such remarkable oxidizing and aerating powers that the effluent, after passing through it, is, to quote an independent report of Dr. E. L. Jacob, Medical Officer of Health to Surrey Combined Sanitary District, "superior to many potable well waters." The precipitant used is magnetic ferrous carbon, and the mode of applying it is to grind it up into a thin slurry with water of sewage, and then to run this liquor into the sewage as it flows into the precipitating tanks. After allowing the sewage in the tank to settle for about three hours, the effluent is passed through the magnetic spongy carbon filter bed, from which it issues in a state of almost perfect purity and flows into the Thames. The sludge, which is very dense, is then drawn off into the sludge well, whence it is pumped into the presses. The amount of sludge obtained per week is 18 tons, and, when pressed, this gives 4 tons 10 cwt. of sludge cake, which has all been sold up to date, and fetches 30s. per ton.

The author considered the magnetic process advantageous over all others, because the effluent is not spoiled by the use of lime, the manurial value of the sludge is much increased, the nuisance which exists at most sewage works where lime is used is not created, and the Thames is not polluted by it.

The Acton local board had at first grave doubts of the efficacy of any filtering bed for sewage, but experiments for a period of nine months convinced them that the "magnetic process" was all that could be desired, and they consequently entered into a contract with the International Purification Company for the supply of their material for a term of five years.

FLOUR is being taken by steamships from the United States to Europe on through shipment from the West at about ballast rates, in the absence of grain for ballast.

PHOSPHORESCENCE AND OZONE.

AT a recent Friday evening lecture of the Royal Institution session, Professor Dewar made public for the first time some discoveries he has made in relation to chemical phenomena in vacuum tubes.

Professor Dewar said that in spectroscopic observations the experimenter is often much puzzled by the phenomena presented in high vacua, and that the perplexity is largely due to the fact that we are unacquainted with the chemical changes which take place under such conditions; so special apparatus has been devised for the purpose of attempting to solve some of the questions. He continued, that friction, heat, light, and electricity will stimulate certain bodies, and cause them to become phosphorescent, and that the cooling of the body may prevent the stimulus; he illustrated this by cooling the center of a plate which had been coated with sulphide of calcium; light then made it phosphorescent everywhere but in the place it had been cooled. Heat increases the luminosity at first, but the luminosity afterward dies out more quickly than where the plate has not been heated.

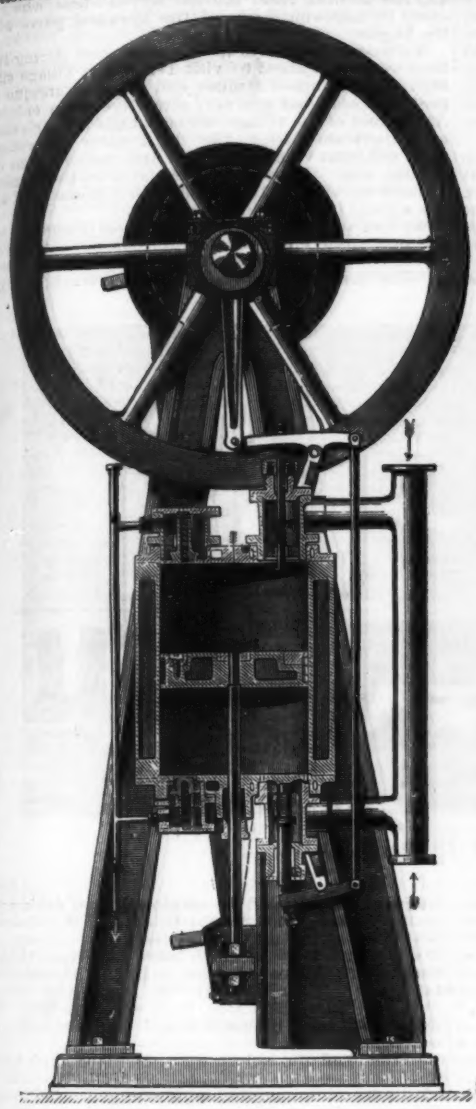


FIG. 1.

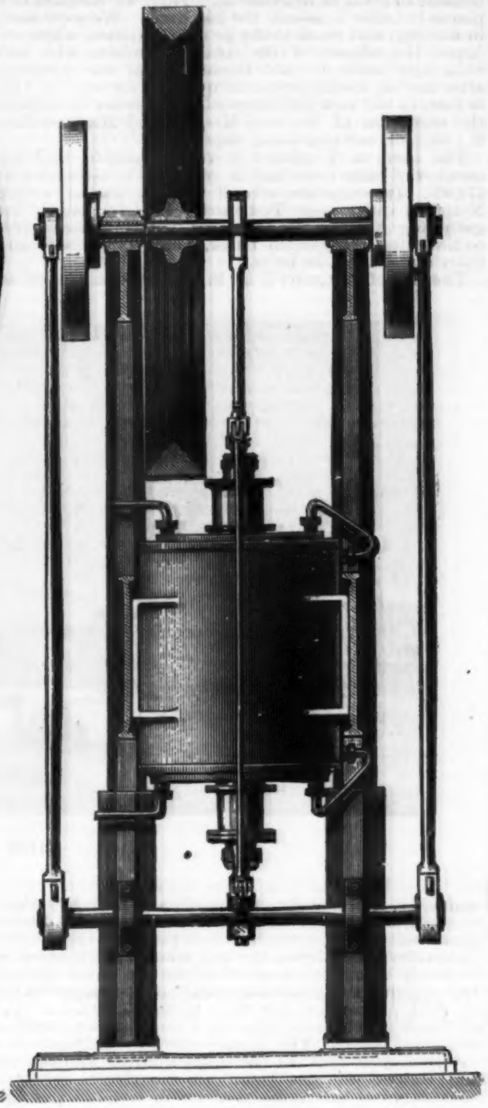


FIG. 2.

NEW AIR PUMP.

FIG. 3.—PHOSPHORESCENT GASES APPARATUS.

Geissler was the first to discover that phosphorescence is sometimes set up in residual gases in vacuum tubes. Professor Dewar illustrated this by sending a discharge through a series of vacuum bulbs, and the traces of gas remained luminous for about five seconds after the discharge had passed; then he heated one of the bulbs, and on passing the discharge once more, that bulb alone remained dark. Becquerel and others investigated these phenomena; some of the inquirers came to the conclusion that they were produced only by oxygen compounds; others thought them to be due to some drying agent used in the construction of the bulbs.

The lecturer then spoke of ozone, saying that it is a very unstable body, which cannot be kept unless produced at a low temperature; its boiling point is about —100 deg. C., and it is a blue liquid; at low temperatures it exhibits high absorbent powers in the luminous part of the spectrum; at a low temperatures, also, substances may be dissolved in it, with which it explodes at high temperatures; bisulphide of carbon is one of these substances. At low temperatures phosphorus does not combine with liquid oxygen, neither does sodium nor potassium. Smell is one of the most delicate tests of the presence of ozone, but inapplicable in the instance of the contents of a vacuum tube; the investigator has then to resort to chemical means and to the study of the absorption spectra. In making ozone from oxygen low pressures and the presence of moisture favor the action, and that low pressure should favor chemical changes is contrary to what might have been expected. When he planned his experiments he wanted an air pump which would keep up a good vacuum all the time that a trace of air was passing through the vessels, and the old air pump of the Royal Institution, although a good one in another sense, was not good enough for this purpose. Accordingly, Mr. Anderson, of the firm of Messrs Easton & Anderson, engineers, advised by Sir Frederick Bramwell, devised a pump for the purpose, which acts so efficiently that one is now used at Cambridge for diminishing air pressure wherever required throughout the building, and Mr. Anderson has presented one to the Royal Institution. This pump is represented in Figs. 1 and 2; its piston rod and valves are very small as compared with the size of the pump, to give less chance of leakage, and the valves are automatic. It is surrounded by a water jacket to keep everything cool, which is a great point. It is worked at from 150 to 200 revolutions per minute, and exhausts into the vacuum of the old pump of the Institution, instead of into the outer air. The two pumps are driven by a Crossley's gas engine. The piston of the new pump fits absolutely tight. By means of the pump, dynamic effects can be obtained in vacuum tubes with the electric discharge going on all the time.

The more essential part of the apparatus used by Professor Dewar is represented in Fig. 3. Common air is first dried and purified by passing through one vessel containing calcium chloride and another containing caustic potash; the latter absorbs the carbonic acid. The air is next filtered by passage through a U tube filled with cotton wool, after which it enters through a carefully adjusted small tap the two-bulbed vacuum tube represented in the cut. The narrow channel between the bulbs is necessary; the glow is concentrated thereby, and heat seems to have something to do with the effects obtained. It makes no difference whether

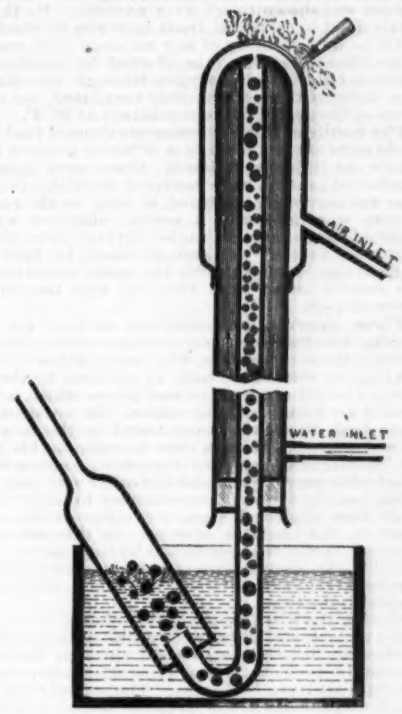


FIG. 4.—OZONE APPARATUS.

platinum, charcoal, or aluminum poles be used inside the vacuum tube. The lower part of the tube opens into a tall glass vessel, connected below with the exhaust pump and a mercurial pressure gauge.

When the current of highly attenuated air blows downward through the vacuum tube, a luminous glow resembling to the eye the tail of a comet appears in the large glass vessel below, while the electrical discharge is passing in the tube above. This phosphorescent glow is "connected with a condition connected in some way with ozone," and it occurs only with oxygen compounds; impure air is fatal to success in the experiments, the glow being very sensitive to traces of organic matter, especially to the vapor of essential oils and substances which have a smell. Hydrogen extinguishes the light; pure oxygen increases it, and makes the glow shorter, with a tendency to break up at the lower end; carbonic acid gives a glow not so bright as air, and ozone is produced in the decomposition of the carbonic acid. Nitrous acid gives a very bright brush. The phosphorescence disappears at once when a pocket handkerchief containing any odoriferous matter is brought near the air inlet, and afterward much time is lost in getting the apparatus to work as before. It is no easy matter to get the brushes back again; this was first found out accidentally—for days and weeks they had been puzzled in the laboratory to understand why one tube worked better than another. Bisulphide of carbon is an organic body, and is the only one so far discovered which allows the glow to be obtained in its presence. That these downward luminous brushes contain ozone is proved by means of the iodide of potassium and starch test papers, which darken in the brushes, but are not acted upon when placed alongside them near the inner sides of the lower glass vessel.

It is usually supposed that ozone is destroyed by heat, and can only be produced at a low temperature, yet in these vacuum tubes it is produced at a white heat. Professor Dewar here exhibited the piece of apparatus represented in Fig. 4, which figure is a copy of one of his wall diagrams exhibited at the lecture. The apparatus consists of a glass tube bent at its lower end, and passing up the center of a tube of platinum; a little hole in the latter is just above the top orifice of the glass tube. The upper part of the apparatus is covered with an outer tube of platinum, which at the top very nearly touches the inner one. In action a current of water flows up the inside of the inner platinum tube, then passes down the central glass tube, but not enough water is supplied to fill the glass tube; consequently it sucks in and carries down air, which it draws through the little hole in the top of the inner platinum tube. The outer tube is then raised at the top to nearly the melting point of platinum, by means of an oxyhydrogen flame, and the air beneath raised to

this temperature is suddenly cooled by the water current, and carried down to a collecting vessel for examination. When examined, it is found to contain ozone; hence ozone has two centers of stability, and one of them is at about the melting point of platinum. In this experiment, ozone is formed by heat at the normal pressure of the atmosphere.

The lecturer closed by expressing his appreciation of the service rendered in his researches by his two assistants, Mr. Lennox and Mr. Heath.

VITALIZING AND DEVITALIZING OXYGEN.

IN the current number of the *Asclepiad* there is, among other valuable articles, a most interesting one by Dr. B. W. Richardson, F.R.S., on the vitalizing and devitalizing action of oxygen on different animals and under different conditions.

In turning back to the records of some of our earlier experimentalists, we find very different opinions expressed as to the action of oxygen on the bodies of men and animals. One observer finds that it acts as an excitant, while another shows evidence to the effect that it is a narcotic and a depressant. Let it be well understood that in all cases ample precautions were taken to keep the chambers in which the animals under experiment were placed free from excess of carbonic acid, and analyses made from time to time proved that this was effected. In spite of these precautions Dr. Richardson suspected that some error had crept in, or that something had been overlooked in the experiments in which oxygen was shown to act as a narcotic. He therefore determined to carry out fresh inquiries in which there could be no possibility of any carbonic acid remaining in the chambers; this was effected by maintaining a continual flow of pure oxygen through the chambers, so as to keep them thoroughly ventilated, the temperature of the gas being kept constant at 60° F.

The results of these experiments showed that freshly made pure oxygen acted in a different manner as a vitalizer on different animals. Some were apparently unaffected; others were rendered feverish; but in no case was narcotism produced, so long as the supply of oxygen was kept up. A second chamber was constructed large enough to be divided into compartments, so that all the animals could be kept in the same oxygen under exactly the same conditions; but the results found were identical with the former in every respect.

These observations, important as they are in confirming the results of one previous writer, contradict entirely those of another, who nevertheless conducted his inquiry with ample care, as will soon be shown, although he did not find the real causes which led to the results he found. These causes, like so many other important discoveries, were found in the most unexpected manner. With a view to examine his oxygen, Dr. Richardson had two reservoirs constructed, one filled with pure oxygen and the other with pure water. After passing through the chamber in which the animals were placed, the gas was collected by displacement in the reservoir of water; in this manner none was lost, except that consumed by the animals. Before being used a second time it was completely dried, and purified from carbonic acid, ammonia, and all appreciable impurities.

During the first passage of this charge of oxygen the same phenomena were produced as in the previous experiments, but on being passed through the chamber a second time a most remarkable change occurred. The animals all became drowsy. The current was quickened, and the gas in the chamber tested, and found to be simply pure oxygen. Still the drowsiness continued. As the experiment proceeded, the drowsiness—which resembled sleep of the quietest character—increased, until at length the startling result was obtained that pure oxygen, after several inhalations, eventually produces death, although no chemical test will show any difference in its composition from that of the freshly made gas.

The other experiments previously referred to, when examined with this new light thrown upon them, are found to be perfectly correct. The oxygen was certainly kept free from carbonic acid, but, owing to the chamber being closed and not having a draught of fresh oxygen continually circulating, it necessarily came to pass that after a few hours all the gas in the chamber had been inhaled over and over again, with the curious result of devitalizing it just described.

The term *devitalizing* does not, however, convey the idea of any known modification in the gas; that it is not chemical in the accepted meaning of the word we have the authority of Dr. Richardson for stating; that there is a change is evident, and we can only hope that chemists will take up the matter and endeavor to find whether this change can be detected by chemical means hitherto unknown.

After having devitalized oxygen, attempts to revitalize it were made, and it was found that this could be easily effected by electrically charging it from a set of brushes connected with the positive pole of a frictional machine.

After having discovered an effect, the next thing to do is to find out the cause, and in this instance the problem set is a difficult one. Dr. Richardson himself inclines to the opinion that "during the contact of the oxygen with the blood or the tissues of the animal, some quality of the gas essential to its vitalizing power is lost, so that the gas becomes negative in its action." This sounds more like restating the fact than finding the cause, and seems hardly sufficient when considered in conjunction with its properties of supporting life in cold-blooded animals, and also supporting flame as vigorously as ever.

However this may be decided, we have several examples of the facts repeatedly occurring, such as what is called the clearing of the air by a thunderstorm, which is evidently a revitalizing of the oxygen by means of the electric discharge.

In these days, when we are constantly hearing of bodies having had some properties modified, although the chemical tests at our command are not subtile enough to distinguish any difference in composition, we fall back on a general and convenient explanation, and say the anomalies are caused by a rearrangement of the molecules. How far will this explanation answer the question set by the facts we have recited? The molecules are all present—why will they support life in a cold-blooded and not in a warm-blooded animal?
—*Chem. News.*

THE FRENCH ASSOCIATION IN ALGERIA.*

THE aga of Tougourt, Si-Smail, whose affability and generous nature are well known, came out to meet us, and we met him at some distance from the city accompanied by a large crowd and escorted by a certain number of cavalrymen of his daira or private guard. We all alighted and thanked the aga for troubling himself to come to welcome us. Then we resumed our places in order to ascend the last dune. We were soon in the city, and reached the principal square, where we found the officers of the Arabian bureau, who had obligingly come to put themselves at our disposal, after having kindly prepared quarters for us. It was, in fact, in the new buildings of the bureau that (with the exception of Mr. and Mrs. B. and Mr. and Mrs. G.) we took our meals and slept.

The oasis of Tougourt is very extensive, and the number of palm trees that it contains is estimated at 170,000. It comprises several villages, one of which, Nezla, is quite near Tougourt. In addition to the gathering of dates, the inhabitants devote themselves to the culture of garden truck, which grows here and there under the date trees.

The city of Tougourt (Fig. 1), which is built upon an eminence, is bounded to the north and west by dunes. On the other sides it was formerly defended by ditches containing stagnant water, which rendered the country unhealthy. Ben-Driss, the aga who was succeeded by Si-Smail, began the work of filling up these ditches; but, unfortunately, the important undertaking was not finished, and a few infectious pools still remain. The city is, with the exception of a few houses, built of sun-dried bricks. The houses are low and have few external openings. In one entire quarter, and not the least important one, there are no streets, properly speaking, but the traffic is done in covered passages beneath the houses. Here and there, the roof ends, and allows a bright light to enter (Fig. 2).

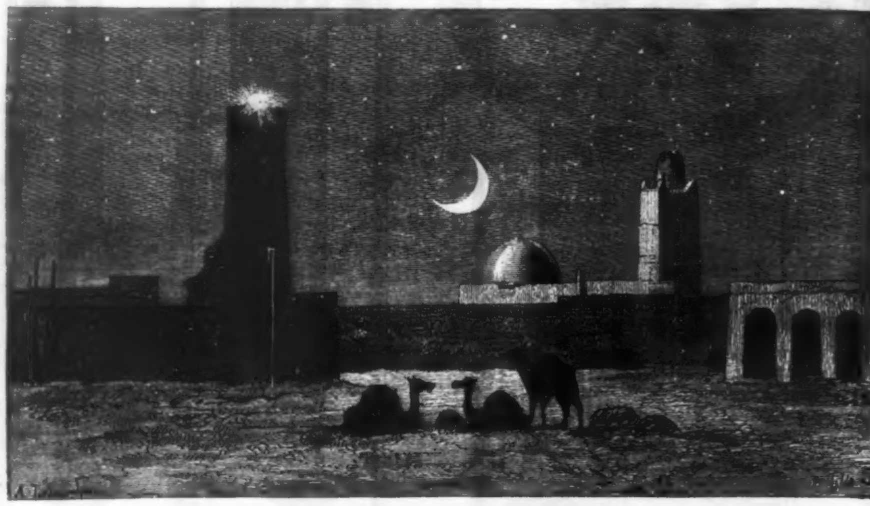


FIG. 1.—VIEW IN TOUGOURT.

Some private dwellings are built of ashlar, but these are rare at Tougourt, and there are none at Nezla, which is a faubourg, where the streets are not covered, and which resembles all the villages that we have seen —El Kantara, Old Biskra, Temacin, etc.

The principal buildings of Tougourt are the aga's palace, a very pompous title for a very simple structure, which exhibits no architectural character either externally or internally, the Arabian bureau, which is not yet finished, the mosque Djama-Kebir, which merits a visit, although it does not present much interest, and the barracks, which comprise a square tower at the summit of which there is an optical station which every evening establishes a communication with Biskra through the intermedium of three analogous stations. It is this tower and the minaret of the neighboring mosque that announce the existence of Tougourt from afar (Fig. 1).

Tougourt is quite an important commercial center, and the market that is daily held there is very animated. There are likewise a few industries represented by workmen who manufacture objects of regular consumption.

The aga, whose hospitality is justly celebrated, invited us to dinner, and we had the double satisfaction of a meal well served in the French style and of a *cuisine* truly indigenous. Very numerous and varied dishes defiled before us for more than three hours, among which we shall merely mention the couscous and the *mechui*, roast mutton served whole, which is eaten by removing strips of the browneat parts with the fingers.

We passed two days at Tougourt, and during this time we were enabled to visit Temacin, a village situated at a distance of 8 miles, and of a picturesque aspect from afar, but not very attractive when entered. At the foot of the village, which is built upon elevated land, there are ditches filled with water possessing a dark ocherous vermilion color, and giving off an unhealthy odor. We pushed on as far as to the Zaouia of Tamelh'at, which is the residence of a pious chief who has a great influence in the country.

We had an entire day in which to see Tougourt and the immediate environs, and we took advantage of it to visit the school, whose director did us the honors of it. The children are taught here in French, and this language alone must be employed even during play spells. This is an excellent thing, and it is desirable that many of the natives shall learn our language; but it would appear to be much more important that the various officials called upon to live in Algeria should take the trouble to learn Arabic. From what we have seen and have been told, there would seem to be no doubt that their influence would be considerably increased thereby.

If time had allowed us, we would have liked to visit Souf; but we were obliged to give up the project. One of our traveling companions, however, decided to make for one point of this quarter, where the country presents quite a peculiar character. It is the region of the dunes, which succeed one another uninterruptedly, the oases occupying the low portions at a very inferior level. These dunes are constantly changing form and shifting under the influence of the wind. The effect of this movement would be to bury the oases if, by continual work, the inhabitants did not defend themselves against the invasion. It has also the effect of so modifying the aspect of the country that it would be impossible to find the road again and take the proper direction, had not the precaution been taken to establish, here and there, on the top of certain dunes, stone pyramids (ghemira), which mark out the route to be followed (Fig. 3).

During this time Mrs. B. and Mrs. G. were allowed to pay a visit to the aga's wife, who gave them a fine reception and presented them with some touareg cushions and some fans. The other travelers, of course, could not visit the native interiors.

After seeing a French well-drilling plant, we had a chance, toward Temacin, to see the native workmen driving a well. The water was already spouting, but there were yet about 150 feet to be dug. The black workmen, almost naked, dived in order to perform

* Continued from SUPPLEMENT, No. 655, page 10469.

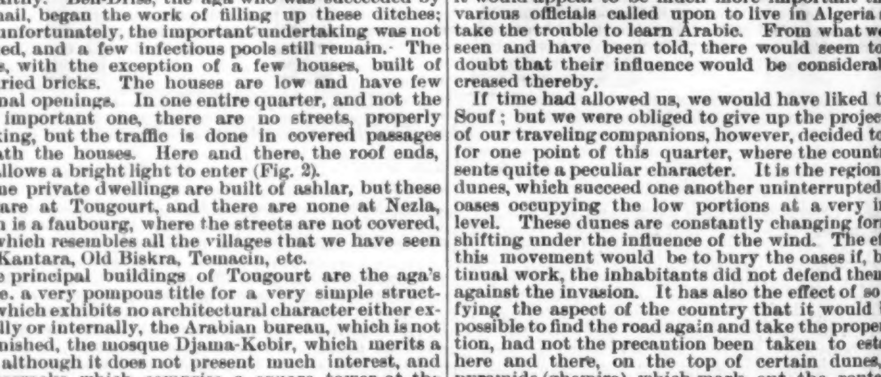


FIG. 2.—COVERED STREET IN TOUGOURT.

their work, and we verified the fact, watch in hand, that they remained nearly three minutes under water (or, to be exact, 178 seconds). We could not think of giving a detailed account of our voyage, but merely a brief summary; we must therefore condense.

Arriving at Tougourt Sunday, April 15, at half past four in the afternoon, we started again on Wednesday, at half past five o'clock in the morning. The return was made under almost exactly the same conditions as those under which we went out, the only difference being in the location of the stations at which we stopped to dine. We can therefore be brief. We shall merely say that, in returning, we visited the third estate of the Batna Agricultural Society, that of Ayata, and then that of Tala-em-Muidi, belonging to Messrs. Fau and Foureau. The bordj belonging to this has a most picturesque aspect (Fig. 4). It is built upon the summit of a small hill, and over the wall are seen emerging the tops of palm trees that have been planted within, and which, by their dark color, form a curious contrast with the walls.

The well is at the side of the bordj, and the water that flows from it has to descend from a certain height in order to be used at the level at which the plantations are located. Advantage has been taken of the resulting fall to actuate a water wheel that runs a mill which is used chiefly by the natives.

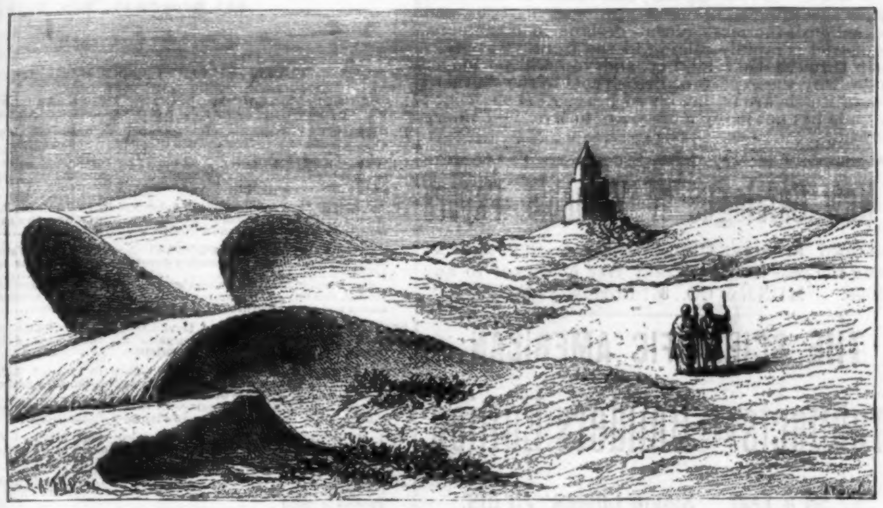


Fig. 3.—SAND DUNES ON THE SOUF ROUTE.

At four o'clock in the afternoon of Saturday, April 21, the tenth day of our excursion, and in conformity with the programme, we were on our way to Biskra. We had been particularly favored, not only because nothing had been lacking in all that had been prepared for us, but also because we had not had to endure any of the inconveniences that might have been expected. The temperature did not exceed 35° in the shade, although at this time of the year it often reaches 42°. Let us add that the dryness of the air renders this temperature quite endurable. The sirocco did not happen to blow during the ten days of the trip. Finally, no one was sick, nor even indisposed, and no one was stung by a venomous animal.

We must add that, in reality, the fatigue was not very great, and that on the day succeeding our arrival at Biskra the entire party divided up for different excursions. This is an important point. It shows that the trip from Biskra to Tougourt is one of those that tourists ought not to fail to make in Algeria if they are not pressed for time. It is not, as is sometimes thought, a question of days to be passed on horse or mule. The excursion is made without difficulty in a wagon, and this can be easily hired at Biskra. It is necessary, of course, to take along food and covering, but these are details that can be arranged at Biskra on the eve of departure.

A few persons now annually make this excursion, and we doubt not that the number must increase. The country is an interesting one to travel over, and to study from more than one point of view. We have given the best recollections of it, and we hope that this short narrative of a voyage made in a country which is not yet very well known will get scientists, artists, manufacturers, and capitalists to go to visit it, in order to judge upon the spot of the profit that can be derived from it. —*G. M. Gariel, in La Nature.*

[Garden and Forest.]

PALMS IN CENTRAL FLORIDA.

Probably in all the United States there is not such a collection of palms growing in the open ground as that of Mr. E. H. Hart, at Federal Point, Putnam Co., Florida. Dr. Richardson, of New Orleans, has a good collection of hardy palms growing in the open ground, but the extremes of cold experienced there are much greater than those of Mr. Hart's location, and only the most hardy species can be safely planted out.

The approach to Mr. Hart's residence is through the orange grove, famous throughout the South for the number and excellence of the varieties of fruit grown, and containing between the orange trees hundreds of the choicest exotic fruit trees, flowering and ornamental shrubs and palms in the greatest variety. It is of the palms more especially that I now wish to speak.

Overlooking masses of Magnolia fuscata, Rhincospermum jasminoides, Olea fragrans, Azaleas, Tabernæmontana, Allamanda, and other beautiful plants, one's attention is first attracted by a group of different species of the genus Phœnix in front of the house. The tallest of these is a magnificent specimen of P. sylvestris, the wild date of India, with a trunk some twelve feet in height and a total height of twenty feet. (It must be remembered that none of Mr. Hart's palms has been planted out more than fifteen years, and most of them during the last ten years, so that in many species stem development has not even begun.) This beautiful tree had bloomed, and a spike of fruit was developing at the time of the extreme cold of 1886; this, of course, was destroyed, and no flowers have appeared since. Close by is a Phœnix canariensis, with a short trunk, and still more elegant leaves than those of P. sylvestris; the leaflets are set closer together, making a very compact and beautiful leaf. Another specimen, though smaller, is Phœnix vinifera, a more tender species, which suffered badly during the winter of 1886, but is still a very handsome and thrifty plant. Among the orange trees are two elegant plants of Phœnix rupicola, a most graceful species. The handsome recurved leaves are a rich golden-green color rarely seen in any palm. These plants are about five feet in height, this species never forming a tall trunk. There are other fine specimens of the different species of Phœnix in different parts of the grounds, especially in what was once the garden, but is now a thicket of palms. We noted also Phœnix tenuis, P. pumila, P. farinifera, P. senegalensis, P. spinosa, P. reclinata, P. dactylifera (the common date palm), and others. In striking comparison with the vigorous, healthy, and remarkable growth of the various species of Phœnix, we remember a tiny plant of Copernicia macroglossa, ten years old, and with one little leaf, not more than an inch high.

Directly in front of the house is a clump of the slender little cane palm (Rhapis flabelliformis). The stems of this miniature palm are about three-fourths of an inch in diameter and two or three feet high. It suckers freely like a bamboo, and the clump now contains fifty or more distinct stems. This palm was little injured by the cold of 1886, and is ordinarily quite hardy.

The neat, trim little specimens of Chamærops throughout the grounds are very beautiful. Among these are C. spinosa, C. Humboldtii, C. arborea, C. elegans, C. tomentosa, C. Martiana, C. Fortunei, C. humilis, C. sinensis, C. farinosa, C. humilis robusta, C. robusta, C. excelsa, C. excelsa macrocarpa, our native C. hystrix (or Rhapidophyllum), and others. One of the largest of these is C. robusta, which has reached a height of six feet, with a trunk three feet high. Many of them have beautiful little silvery leaves and small slender trunks from three to five inches in diameter. All are perfectly hardy in this latitude, so far as cold weather is concerned, but C. humilis and one or two others do not, while small, support our summer sun very well. C. excelsa has rich green leaves, without the silvery tint so often seen in the other species.

Among other fan-leaved palms is a splendid collection of Sabals. These are usually hardy; even the species whose native home is in the tropics. One magnificent specimen of S. umbraculifera has attained a height of about fifteen feet, with over six feet of trunk. It has a beautiful spreading crown of leaves resembling those of our native S. palmetto, though with longer and stouter petioles, and thicker, firmer texture. A specimen of S. dealbata is about six feet in height. This has produced seed on a spike ten feet high. There is a fruiting specimen of S. longipedunculata, with the flower spikes extending far above the leaves after the manner of Sabal Adansonii. A fine specimen of Sabal Mocini, from the highlands of Mexico, has proved somewhat more tender than the native cabbage palmetto, the foliage having suffered in 1886. There are in this collection also Sabal havanensis, S. Ghiesbrechtii, and S. cœrulescens, all in good specimen plants.

Mr. Hart has made a great success with Washingtonia robusta, one of the California fan palms, of which he has several fine trees. The largest is fifteen feet in height, with about six feet of trunk; it throws out a new leaf every two weeks, and is indeed a beautiful specimen; the red wax-like spines and richly tinted leaves and petioles make it one of the handsomest and most desirable fan palms I have ever seen. Washingtonia filifera (Brahea or Pritchardia filamentosa), the Southern Californian palm, is very distinct. Although Mr. Hart has beautiful specimens, they are deficient in vigor as compared with those of W. robusta. Brahea edulis and Brahea glauca are represented in smaller specimens.

Perhaps the most elegant palm in the whole collection is a ten-year old Diplothemium campestre. It is not more than four or five feet in height, but the beautiful plume-like leaves, silvery on the under side, and the leaflets delicately curled like those of an ostrich feather, make up in beauty for want of size.

The genus Cocos is well represented in the more hardy species; a specimen of the quick-growing and handsome C. flexuosa is twelve feet high; the most hardy species, perhaps, of all pinnate-leaved palms, C. australis and C. campestris, are represented by many thrifty young specimens. C. Yatai, C. Insignis, C. Romanzoffiana, C. Normanbyana, C. Gaertneri, and C. Blumenavia are represented in small specimens; C. plumosa, a species with long, drooping, light green leaves, appears in a good sized specimen.

I noticed a small plant of Livistona altissima, another of L. Jenkinsiana, and a splendid specimen of L. Hoogendorpii four or five feet high. In front of the house is a magnificent specimen of L. chinensis, about eight feet high, that has formed a considerable trunk already. Near by is an Acrocomia sclerocarpa about four feet high, raised from a seed planted eight years ago, and which did not germinate for four or five years.

A Jubæa spectabilis, twelve years old, and not over a foot high, though apparently healthy, seems to warrant the assertion that in Chili, its native country, this palm is one hundred years old before it produces flowers and seed.

Areca rubra, A. sapida, and other species of this genus, are grown with the protection of a shelter made of slats placed several inches apart, in order to afford partial shade and protection from frost.

A good specimen of Oreodoxa regia, the "Royal Palm" of Southern Florida and the West Indies, has been protected through several severe cold snaps by headless and bottomless barrels slipped down over the leaves and around the trunk, and then filled up with earth.

Many other palms are represented in small specimens, but I have noticed most of those that have attained any size.

Cycads, too, are well represented. First and foremost there is a noble specimen of Cycas revoluta, about fifteen years old, and in the healthiest possible condition. Scattered in various places throughout the grove and grounds are at least as many as a hundred more small specimens of the plant. Zamia integrifolia, our Florida species, is there, as well as the rarest exotic species, like Macrozamia cylindrica, M. Dennisonii, Dioon edule, Cycas circinalis, Macrozamia terrestris, etc. In a few years the "Palms of Federal Point" will be well worth a long journey to see.

P. W. Reasoner.

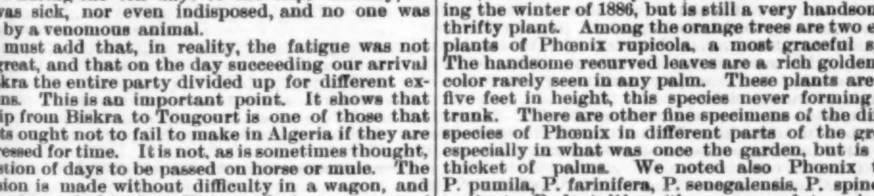


Fig. 4.—BORDJ OF TALA-EM-MUIDI.

A MODEL POULTRY FARM.

It has long been my desire to visit the largest poultry farm in the world, consequently, when the train reached Lancaster, Mass., I proceeded at once to the home of Mr. A. C. Hawkins, who is acknowledged everywhere to be the largest and most successful breeder in the world. I was warmly welcomed by the genial proprietor, and after a drive to the depot to carry the day's shipment of eggs, we started on a tour of inspection through the extensive yards. The buildings are built for comfort rather than display, and answer the purposes for which they are intended as well as those costing twice as much. The buildings are all 12 ft. wide, and taken together are 3,000 ft. long. The houses are subdivided into apartments 12×20, and in each of these 30 fowls are kept through the winter. Mr. Hawkins finds that 30 hens will lay more eggs in such a room than 50. Mr. Hawkins makes a specialty of Plymouth Rocks and Wyandottes, both white and laced, and winters each year about 1,000 Plymouth Rocks, 325 white Plymouth Rocks, and the latter number of both white and laced Wyandottes. He also keeps for breeding purposes about 75 Pekin ducks and a small flock of bronze turkeys.

Mr. Hawkins is a very careful and judicious breeder, and keeps a perfect pedigree of all his stock, and never

makes a mating by guesswork. He took up the Wyandottes when they were admitted to the standard, and by the same system of scientific breeding that has brought his strain of Plymouth Rocks so near perfection, he has produced a strain of Wyandottes that breed very true to color and form—large in size and with small combs. He sold matings of Wyandottes last season that produced as large a per cent. of first class breeding birds as his Plymouth Rocks, and the great success he has attained at the exhibitions is the best proof that his Wyandottes are second to none in the country.

Foreseeing the great boom in white Wyandottes, Mr. Hawkins purchased the originator's entire stock of this variety in the spring of 1886, and has raised a large number of birds from them. He devotes an entire farm to this variety, and is having a great demand for the stock. The most important part of his business is furnishing fine breeding stock, and eggs for hatching, to his customers, in all parts of the world. He has sent either fowls or eggs with success to New Zealand, Austria, Germany, France, England, Scotland, Ireland, and Denmark, and his Plymouth Rocks and Wyandottes can be found in nearly every hamlet on this continent.

Eggs shipped to England and Germany have hatched 60 per cent., and in California 90 per cent. Mr. Hawkins believes that it pays to ship to customers only first class stock, and by his square and honorable methods of dealing, he has won the respect and confidence of the poultry fraternity, and has created a very large and constantly increasing trade. The sales of pure bred stock and eggs from his farm in 1887 were over $15,000.

Mr. Hawkins tells us that his hens average 130 eggs each per year. When he commenced business twelve years ago he kept 50 fowls, and the farm from which he now realizes over $15,000 per year did not produce enough to cover as many cents. A taste for the business, fair and honest dealing, and persistent work with body and mind are the secrets of his success.

Mr. Hawkins, after repeated trials with various incubators, has discarded them all and decided that the "old hen" is best. He has at this writing 3,500 chicks, and expects to hatch at least 1,500 more. Twelve chicks are allotted to each hen, and these are placed in small coops scattered over the farm. When five weeks old, hens are returned to the laying pens and the chicks are placed in colonies of 35 to 40. They have a small movable coop for shelter, and are allowed to roam at will until old enough for market. The inferior and poorly marked chickens are killed as broilers, and at present bring 50 cents per pound. To provide room for this vast army of chicks to roam necessitates the hiring of 600 acres of land. The chicks are well taken care of and are fed for the first few weeks a mixture of equal parts corn meal, oatmeal, and middlings boiled in milk.

In addition to the poultry business Mr. Hawkins has the most extensive fruit orchard in this vicinity. It contains 4,000 plum, 1,000 quince, and 1,000 pear trees. 1,700 of these were set last spring. Some of the plum trees are just commencing to fruit. About 350 bushels of plums were sold last year at $4 per bushel. The quinces and pears are not yet old enough to bear full crops.

Five acres of Cuthbert raspberries were set last spring. When this orchard gets to bearing, we predict that the returns from it will even eclipse those from the poultry department. We have always maintained that there was no better place for a smart, energetic young farmer to settle than in New England, and the success Mr. Hawkins has achieved can be equaled by hundreds of other young farmers if they will make their calling a business, devote their time and attention to it, and labor diligently.—*G. A. R., N. E. Farmer.*

EUROPEAN COAL MINING.

"Chance threw me recently into the company of an American mining engineer who has been traveling all over Europe for the purpose of making himself acquainted with the various systems and diversities of system prevailing in the different coal mining localities. He was, like most of his countrymen, very communicative, and, like them also, very fond of expressing the opinion he had formed on various mining matters in the course of his travels. As the opinion of an American is usually unbiased, and always well founded, I will quote some of his remarks:

"'The French,' said he, 'are going ahead. The difference between the coal mining of to-day and that of twelve years ago would do credit to any American district. I speak only of the north, and they tell me that is the only go-ahead part; but in that locality there is improvement everywhere. The miners of the Nord and the Pas-de-Calais are up to the times. If you want to see the most scientific mining in the world, go to the Anzin or the Lens collieries. It is not yet the most economical; it is, perhaps, too scientific. But economy will follow. This truth you English will probably learn in time from the diminishing exports of coal to France, which must assuredly result.

"'Belgian mining? Well, there is something to learn in Belgium, too. I am inclined to think that coal is got more cheaply there than anywhere else. Not at the lowest cost per ton, of course, but most cheaply, having regard to the work done. Belgian seams are thin, all of them. Many of them are very thin. In America we should not touch them. But the Belgian gets them out somehow, and dumps his coal at the top of a deep shaft at a cost that enables him to compete with his more highly favored neighbors, the Germans. Then, again, his ground is much disturbed. There is not much straightforward work. It is all up and down, in and out, twisting and turning. No man should consider himself a good, all round engineer who has not had some experience in the Belgian mines.

"'And Germany? Westphalian mining? Well, there you have another state of things. The Westphalian coal seams are thick and regular. No disturbance there to trouble you. All is straightforward, plain sailing, as far as the seams are concerned. But there is water—abundance of water. As I would send a young man to Belgium to learn how to deal with thin and broken seams, so I would send him to West Germany to study water engineering. Your German miner is systematic. His work is laid out in the most orderly manner conceivable. He is all order and system. As the Frenchman is scientific, and the Belgian clever and full of resources, so the German is painstaking and systematic. He is, perhaps, too fond of order by arrangements and pleasing designs. His surface works, for example, are a pleasant contrast to the rough, unsightly structures to be seen in England, but they cost him a lot of money, and are a tax upon his coal.

"'English more practical? Well, yes, in some respects, but generally more swayed by prejudice. The British miner is too conservative—too apt to think he has reached the highest point in everything, and that consequently neither he nor anybody else can devise anything better. He is an efficient workman, and knows how to get coal cheap; but then he has no great difficulties to encounter. Nature has highly favored him. From his thick, flat, and regular seams, in ground that is generally free from water, he can raise coal at a lower price than anybody else in Europe, or perhaps in the world. With these advantages he can hold his own against all comers. He knows that, and so does not trouble himself either with science or system.

"'I tell you what it is,' said my traveling companion in concluding his critical remark on the several nationalities which had come under his notice, 'if you want to see good mining, scientific and systematic, clever and efficient, you should go to Russia. Yes; the statement is startling, no doubt, but in the Donetz coal field you will see the best examples of mining, taken all round, in the world. A rich, regular, and extensive coal field, worked according to the most approved methods, and supplied with the most recent designs in machinery, this district is rapidly coming to the front. Just take a trip through that locality, and you will no longer wonder why the exports of British coal to the southern ports of Russia are falling off so heavily. Your Black Sea trade has not many more years to live.'"—*Colliery Guardian.*

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